



# **Optimization Review Report Operation and Maintenance Optimization Study**

**Colbert Landfill Superfund Site  
Spokane County, Washington  
EPA Region 10**

## **OPTIMIZATION REVIEW**

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### **COLBERT LANDFILL SUPERFUND SITE, SPOKANE COUNTY, WASHINGTON EPA REGION 10**

FINAL REPORT  
January 2018



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## EXECUTIVE SUMMARY

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### NATIONAL OPTIMIZATION STRATEGY BACKGROUND

The U.S. Environmental Protection Agency's (EPA's) definition of optimization is as follows:

*“Efforts at any phase of the removal or remedial response to identify and implement specific actions that improve the effectiveness and cost-efficiency of that phase. Such actions may also improve the remedy's protectiveness and long-term implementation, which may facilitate progress towards site completion. To identify these opportunities, Regions may use a systematic site review by a team of independent technical experts, apply techniques or principles from Green Remediation or Triad, or apply some other approaches to identify opportunities for greater efficiency and effectiveness.”<sup>1</sup>*

An optimization review considers the goals of the remedy, available site data, conceptual site model (CSM), remedy performance, cost-effectiveness, technical improvement, and closure strategy. A strong interest in sustainability has also developed in the private sector and within federal, state, and municipal governments. Consistent with this interest, principles of green remediation and environmental footprint reduction are now routinely considered during optimization reviews, when applicable.

This optimization review includes reviewing site documents, interviewing site stakeholders, visiting the site for one day and compiling a report that includes recommendations intended to improve the following:

- Remedy effectiveness
- Technical improvement
- Cost reduction
- Progress to Site closure
- Environmental footprint reduction

The recommendations are intended to help the site team identify opportunities for improvements in these areas. Analysis of recommendations, beyond that provided in this report, may be needed before implementation of recommendations. All recommendations are based on an independent review and represent the opinions of the optimization review team. The recommendations are not requirements; they are provided for consideration by the EPA Region and other site stakeholders. Also, note that while the recommendations provide some details, they do not replace other, more comprehensive, planning documents such as work plans, sampling plans, and quality assurance project plans (QAPPs).

The national optimization strategy includes a system for tracking the outcome of the recommendations and includes a provision for follow-up technical assistance from the optimization review team as mutually agreed upon by the site management team and EPA Office of Superfund Remediation and Technology Innovation [OSRTI].

<sup>1</sup> EPA, 2012. Memorandum: Transmittal of the National Strategy to Expand Superfund Optimization Practices from Site Assessment to Site Completion. From: James. E. Woolford, Director Office of Superfund Remediation and Technology Innovation. To: Superfund National Policy Managers (Regions 1 – 10). Office of Solid Waste and Emergency Response (OSWER) 9200.3-75. September 28.

## **SITE-SPECIFIC BACKGROUND**

The Colbert Landfill Superfund Site (Site) is located approximately 2.5 miles north of Colbert, Washington, and approximately 15 miles north of Spokane, Washington. Groundwater impacts associated with the Site extend west to the Little Spokane River, which is approximately 3,000 feet to the west of the closed landfill. Groundwater impacts associated with the Site also extend more than 1 mile to the south of the closed landfill. There are also groundwater impacts that extend up to several thousand feet north and east of the closed landfill.

Surrounding land use is primarily residential developments and undeveloped land. The area south of the Site contains forested lands, open fields, and a few residential homes. There are residences located within the footprint of the groundwater plume (beyond the landfill) in all directions around the landfill.

The landfill operated from 1968 to 1986. During a five-year period between 1975 and 1980 the Landfill accepted solvent and other chemical waste from several entities. Typically, these wastes were delivered to the landfill in 55-gallon drums and were subsequently poured into open trenches to mix with the soil or ordinary municipal refuse already in the trench. In 1980, nearby residents complained to the Eastern Regional Office of the Washington Department of Ecology (Ecology) about the chemical disposal practices. Investigations followed, and EPA placed the Site on the National Priorities List (NPL) in 1983. Subsequent activities included a Remedial Investigation/Feasibility Study (RI/FS), extending public water supplies to affected residents, landfill closure, and design and implementation of a groundwater pump and treat (P&T) system. In 2010 a Remediation System Evaluation (RSE) was conducted, which recommended considering a P&T system shutdown test. The shutdown test began in April 2014 and is ongoing as of the initiation of this optimization review.

The goal of the optimization review is to review historical data and data from the shutdown test to help identify improvements to remedy function and Site-wide progress toward cleanup goals.

## **SUMMARY OF CONCEPTUAL SITE MODEL AND KEY FINDINGS RECOMMENDATIONS**

The original source of contamination was the release of liquid waste to landfill trenches. However, vertical migration of that waste through soil and into groundwater has resulted subsurface contamination that has served as an ongoing source of dissolved groundwater contamination since the initial release. Mass removal and groundwater monitoring data suggest that the majority of contaminant mass in the vadose and shallow groundwater has been flushed from the aquifer, removed by the P&T system, or removed by the landfill gas (LFG) system. The majority of the remaining VOC mass is in deeper saturated zone soil and groundwater. The primary contaminants of concern (COCs) include 1,1,1-trichloroethane (1,1,1-TCA), 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), trichloroethene (TCE), and tetrachloroethene (PCE). 1,4-dioxane has also been identified in groundwater above the Washington State Model Toxics Control Act criterion.

The geology consists of vertically stratified and laterally discontinuous geologic units derived from glacial material, modified by erosional (and possibly landslide) process, overlaid on granitic bedrock, resulting in a complex hydrogeological setting. The six geological units defined at the Site are the upper aquifer, lacustrine unit, lower aquifer, Latah Formation, basalt that is interbedded with the Latah Formation, and granite.

Despite approximately 20 years of P&T operation there were several areas in the lower aquifer and basalt off-landfill property where COC concentrations were not meeting cleanup criteria, suggesting that the sources of contamination and contaminant transport pathways were not fully understood. Additionally, a shutdown test of the P&T system that began in April 2014 has resulted COC concentration increases occurring outside of the landfill boundary. Review of the historical data and the recent shutdown test data suggested several data gaps, including uncertainty in i) the location and extent of the source of contamination to the lower aquifer, ii) groundwater flow paths, iii) the extent of the 1,4-dioxane plume, iv) the presence of per- and polyfluoroalkyl substances (PFAS), and v) the plume width that is migrating off the landfill property to the west.

## RECOMMENDATIONS

Several recommendations were provided that are focused on cost-effectively and efficiently improving remedy effectiveness and accelerating Site closure. These recommendations are summarized as follows:

- Extraction well CP-W3 should be restarted to capture the contamination currently migrating past CP-W3 to the west. Extraction wells CP-W1, CP-W2, CP-E1, and CP-E3 should not be restarted at this time because they may affect groundwater flow directions and compromise the capture provided by CP-W3. CP-E2 should also be restarted because its flow rate is sufficiently low that it will not adversely affect capture provided by CP-W3 and it is effective at removing mass from the basalt and providing some degree of source control.
- Plume delineation in the vicinity of CP-W3 should be improved to ensure it is effectively and efficiently controlled by restarting CP-W3.
- The supplemental sampling program is providing useful information about remedy performance and should be conducted on an annual basis.
- Contamination in the basalt and Latah Formation appears to be the source of ongoing contamination to the lower aquifer, and these units help define the distribution and extent of the source area. Additional characterization of these units is merited. Three additional basalt monitoring wells plus aquifer testing is recommended to better characterize these formations.
- Additional characterization is needed between the landfill and the location of monitoring wells CD-26 and CD-23C2 to better understand contaminant transport in this direction. Two additional monitoring wells and sampling are recommended.
- Sampling for 1,4-dioxane across a broader network of monitoring wells is recommended to help define the extent of the 1,4-dioxane plume.
- The Colbert Landfill received wastes from FAFB that were subsequently labeled as hazardous. In addition, groundwater near the FAFB has been found to contain PFAS, likely associated with the use of aqueous film forming foam (AFFF) containing PFAS. It is not known whether any of the FAFB wastes disposed of at the landfill may have included any PFAS containing materials. Sampling for PFASs is recommended.
- Several recommendations are included for improving the reporting and presentation of data.

- A recommendation is included to reduce the frequency of the upper aquifer monitoring given the remedial progress made in that unit and the low COC concentrations.

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## NOTICE AND DISCLAIMER

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Work described herein, including preparation of this report, was performed by HydroGeoLogic, Inc. (HGL) for the U.S. Environmental Protection Agency (EPA) under Task Order 0066 of EPA contract EP-S7-05-05 with HGL. The report was approved for release as an EPA document, following the Agency's administrative and expert review process.

This optimization review is an independent study funded by EPA that evaluates existing data, discusses the conceptual site model (CSM), analyzes remedy performance, and provides suggestions for improving protectiveness, reducing cost, and making progress toward Site closure at the Colbert Landfill Superfund Site (Site). Detailed consideration of EPA policy was not part of the scope of work for this review. This report does not impose legally binding requirements, confer legal rights, impose legal obligations, implement any statutory or regulatory provisions, or change or substitute for any statutory or regulatory provisions. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by EPA.

Recommendations are based on an independent evaluation of existing Site information, represent the technical views of the optimization review team, and are intended to help the Site team identify opportunities for improvements in the current remediation strategy and operation and maintenance (O&M) plan. These recommendations do not constitute requirements for future action; rather, they are provided for consideration by the EPA Region and other Site stakeholders.

While certain recommendations may provide specific details to consider during implementation, these are not meant to supersede other, more comprehensive planning documents such as work plans, sampling plans and Quality Assurance Project Plans (QAPPs), nor are they intended to override Applicable or Relevant and Appropriate Requirements (ARARs) established in the Record of Decision. Further analysis of recommendations, including review of EPA policy, may be needed before implementation.

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## PREFACE

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This report was prepared as part of a national strategy to expand Superfund optimization practices from site assessment to site completion<sup>1</sup> implemented by the U.S. Environmental Protection Agency Office of Land and Emergency Management (OLEM), Office of Superfund Remediation and Technology Innovation [OSRTI]. The project contacts are as follows:

ORGANIZATION	CONTACT	CONTACT INFORMATION
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<sup>1</sup> EPA, 2012. Memorandum: Transmittal of the National Strategy to Expand Superfund Optimization Practices from Site Assessment to Site Completion. From: James. E. Woolford, Director Office of Superfund Remediation and Technology Innovation. To: Superfund National Policy Managers (Regions 1 – 10). Office of Solid Waste and Emergency Response (OSWER) 9200.3-75. September 28.



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## LIST OF ACRONYMS AND ABBREVIATIONS

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µg/L	micrograms per liter
AFFF	aqueous film-forming foam
ARAR	Applicable or Relevant and Appropriate Requirement
ARD	Assessment and Remediation Division
cDCE	cis-1,1-dichloroethene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
CSM	conceptual site model
DCA	dichloroethane
DCE	dichloroethene
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FAFB	Fairchild Air Force Base
FYR	Five-Year Review
HGL	HydroGeoLogic, Inc.
HQ	EPA Headquarters
LFG	landfill gas
gpm	gallons per minute
MAC	Maximum Acceptable Concentration
MCL	Maximum Contaminant Level
MFS	Minimum Functional Standards
MTCA	Model Toxics Control Act
NCP	National Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance
OLEM	Office of Land and Emergency Management
ORD	Office of Research and Development
OSRTI	Office of Superfund Remediation and Technology Innovation
PCE	tetrachloroethene
PFAS	per- and polyfluoroalkyl substances
PRP	potentially responsible party
P&T	pump and treat
QAPP	Quality Assurance Project Plan
R10	Region 10
RAO	Remedial Action Objective
RD/RA	Remedial Design/Remedial Action
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPM	Remedial Project Manager
RSE	Remediation System Evaluation
RSLs	Regional Screening Levels
TCA	trichloroethane
TCE	trichloroethene
VOC	volatile organic compound

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## 1.0 OBJECTIVES OF THE OPTIMIZATION REVIEW

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For more than a decade, the Office of Land and Emergency Management (OLEM) of the Office of Superfund Remediation and Technology Innovation (OSRTI) has provided technical support to the U.S. Environmental Protection Agency (EPA) regional offices by using independent (third party) optimization reviews at Superfund sites. The Colbert Landfill Superfund Site (CERCLIS ID# WAD980514541) (Site) was nominated for an optimization review by the Region 10 (R10) Site Remedial Project Managers (RPMs) and Optimization Coordinators in January 2017. The focus of this optimization review is to evaluate historical data as well as recent data from the pump and treat (P&T) shutdown test and provide recommendations to optimize the current remedial response.

This optimization review used existing environmental data to interpret the conceptual site model (CSM), identify potential data gaps, and recommend improvements to the Site operations and maintenance (O&M). The optimization review team evaluated the quality of the existing data before using the data for these purposes. The evaluation for data quality included a brief review of data collection and management methods (where practical, the Site Quality Assurance Project Plan (QAPP) is considered), the consistency of the data with other Site data, and the potential use of the data in the optimization review. Data that were of suspect quality were either not used as part of the optimization review or were used with the quality concerns noted. Where appropriate, this report provides recommendations made to improve data quality.

## 2.0 OPTIMIZATION REVIEW TEAM

The optimization review team, which collaborated with representatives of EPA Headquarters (HQ) and EPA R10, consists of the independent, third-party participants listed in Table 1.

*TABLE 1. Optimization Review Team*

Name	Organization	Telephone	Email
Doug Sutton <sup>1,2</sup>	HydroGeoLogic, Inc.	732-233-1161	<a href="mailto:dsutton@hgl.com">dsutton@hgl.com</a>
Mindy Vanderford <sup>1,2</sup>	HydroGeoLogic, Inc.	713-838-7778	<a href="mailto:mvanderford@hgl.com">mvanderford@hgl.com</a>

<sup>1</sup> Attended the Site meeting on May 25, 2017.

The following individuals contributed to the optimization review process, including attendance at the R10 review meeting or Site visit:

*TABLE 2. Other Optimization Review Contributors*

Name	Organization	Title/Role
Jeremy Jennings	EPA R10	Remedial Project Manager
Bernie Zavala	EPA R10	Hydrogeologist
Kira Lynch	EPA ORD	Optimization Coordinator
Jen Edwards	EPA ARD	ARD Optimization Liaison

Notes:

*ARD = EPA Assessment and Remediation Division*

*ORD = Office of Research and Development*

Documents reviewed for the optimization effort are listed in Appendix A.

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## 3.0 SITE BACKGROUND

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### 3.1 SITE DESCRIPTION

Colbert Landfill is located approximately 2.5 miles north of Colbert, Washington, and approximately 15 miles north of Spokane, Washington. The closed landfill is bounded by Elk-Chattaroy Road on the east and Big Meadows Road on the south. Groundwater impacts associated with the Site extend west to the Little Spokane River, which is approximately 3,000 feet to the west of the closed landfill. Groundwater impacts associated with the Site also extend more than 1 mile to the south of the closed landfill. There are also groundwater impacts that extend up to several thousand feet north and east of the closed landfill. Figure 1 illustrates the location of the landfill, the extraction network, the Little Spokane River, and some of the Site monitoring wells.

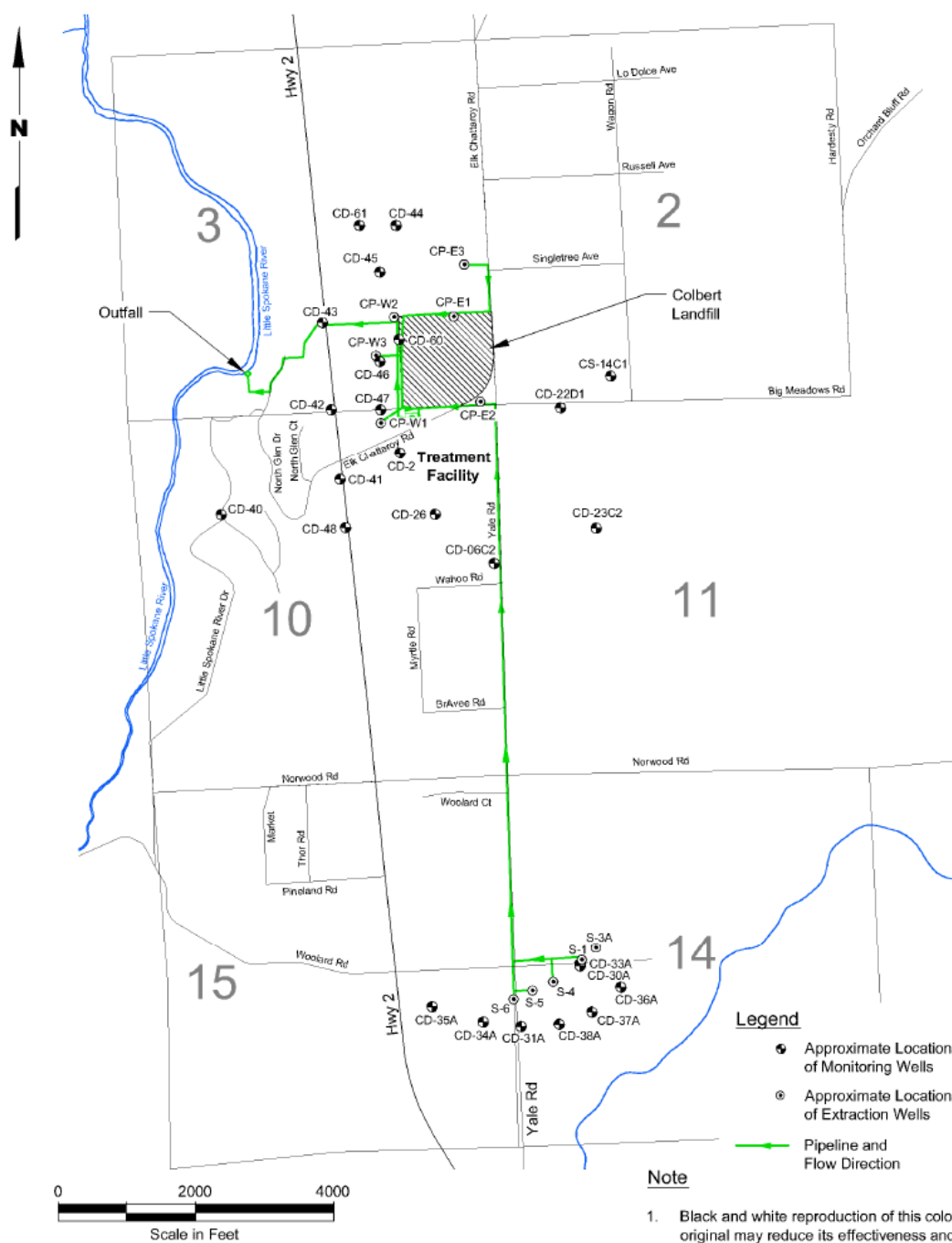
Surrounding land use is primarily residential developments and undeveloped land. The area south of the Site contains forested lands, open fields, and a few residential homes. The Spokane County Recycling Center and Transfer Station is located immediately west of the groundwater treatment facility. There are no residences located within the current footprint of the groundwater plume (beyond the landfill) except for residential well 1073D-1, which is located west of the landfill at the edge of the Little Spokane River.

The landfill operated from 1968 to 1986. During a five-year period between 1975 and 1980 the Landfill accepted solvent and other chemical waste from several entities, including Key Tronic Corporation (a local electronic manufacturing company) and Fairchild Air Force Base (FAFB). Typically, these wastes were delivered to the landfill in 55-gallon drums and were subsequently poured into open trenches to mix with the soil or ordinary municipal refuse already in the trench. According to Table 1 of the Record of Decision (ROD), the primary solvents from Key Tronic were methylene chloride and 1,1,1-trichloroethane (1,1,1-TCA), and the primary solvents from FAFB were methyl ethyl ketone, poly thinner, enamel thinner, toluene, paint remover, and primer wastes.

In 1980, nearby residents complained to the Eastern Regional Office of the Washington Department of Ecology (Ecology) about the chemical disposal practices. EPA and Ecology along with Spokane County Utilities Department conducted an investigation into these complaints by initiating a groundwater sampling study of nearby domestic water wells. Twenty domestic water wells had samples with contaminants at concentrations above drinking water standards which could in part be traced to the spent solvents disposed of at the landfill. Following the initial domestic groundwater sampling investigation, Phase I and II studies resulted in the installation of monitoring wells, injection testing, and development of a groundwater monitoring program. In 1983, EPA placed the Colbert Landfill on the National Priorities List (NPL) and identified Spokane County, Key Tronic Corporation and FAFB as potentially responsible parties (PRP). In 1984, Ecology entered into a cooperative agreement with EPA for conducting a Remedial Investigation/Feasibility Study (RI/FS). During that same year, bottled water was supplied to some of the households with high contamination levels in their water wells.

In 1985, the County extended the Whitworth Water District public water supply main to affected households where concentrations of contaminants were greater than Maximum Contaminant Levels (MCLs). The PRPs funded extension of municipal water to the residents less than 500 feet from a water supply main, provided the resident signed a hold-harmless agreement. Other residents who did not meet these conditions elected to receive this water supply at their own expense. Additional Site history is described in Table 3, including design, installation, and operation of a P&T system. In 2010 a

Remediation System Evaluation (RSE) was conducted, which recommended considering a P&T system shutdown test. The shutdown test began in April 2014 and is ongoing as of the initiation of this optimization review.



**Figure 1:** Colbert Landfill Superfund Site. [Excerpted from Final Work Plan Groundwater Pump & Treat System Shutdown Test (Landau, 2013). Reproduced in Appendix B.]

*TABLE 3. Colbert Landfill Site Chronology*

Date	Event
1968	Landfill operations began.
1980	Contamination identified in local residential water supply wells.
1983	The Site was listed on the NPL.
Fall 1985	An alternative water supply was provided as an interim remedial measure.
September 1987	The RI/FS was completed.
September 1987	An interim ROD was signed.
February 1989	The Consent Decree for the Remedial Design/Remedial Action (RD/RA) was finalized.
July 1993	The RD for the remedy described in the interim ROD was finalized.
July 1994	The first Five-Year Review was completed.
August 1996	Construction started on the landfill closure.
February 1997	Construction was completed on the P&T system.
May 1997	Landfill closure construction was completed.
April 1998	Three of the four south system extraction wells were placed on stand-by.
September 1999	The second Five-Year Review was completed.
June 2004	The fourth south system extraction well was placed on stand-by.
September 2004	The third Five-Year Review was completed.
January 2005	West system extraction well CP-W1 was placed on stand-by.
September 2009	The fourth Five-Year Review was completed.
October 2010	Remediation System Evaluation (RSE) final report was submitted.
2011	The institutional control plan was completed.
August 2013	The Final Work Plan Groundwater Pump & Treat System Shutdown Test was submitted.
October 2013	Samples were collected from new well CD-49 as part of the shutdown program.
April 2014	The shutdown test was initiated by placing all remaining extraction wells in stand-by mode.

### 3.2 REMEDIAL ACTION OBJECTIVES

The 1987 ROD identifies the following objectives:

- Prevent further spread of contaminated groundwater (in the south and west) in two aquifers by installing and operating interception wells and treating the extracted groundwater
- Remove contaminated materials (in the east) which have entered the aquifers and are contributing to the contaminant plume, by installing and operating extraction wells in the area where the plumes originate and treating the effluent
- Provide an alternate water supply system to any residents who are deprived of their domestic supply by demonstrated contamination from the landfill or due to the action of the extraction systems

The 1987 ROD stated that extraction wells and pumping rates should be implemented to prevent contamination from migrating beyond the down-gradient extent of the plume (at the time of the remedy implementation). Table 4 summarizes the 1987 ROD performance criteria that must be met in groundwater for the remedy to be complete. Evaluation Criteria and Adjustment Criteria that are defined the Consent Decree are also included Table 4 along with the current MCLs and EPA Regional Screening Levels (RSLs). The current MCLs and RSLs are provided for reference because performance criteria may change when toxicity data are reviewed or a new ROD is issued.

**TABLE 4. Various Groundwater Performance and Evaluation Values for the Site**

Contaminants of Concern (COCs)	ROD Performance Criteria and Basis (µg/L)	Consent Decree Evaluation Criteria <sup>1</sup> (µg/L)	Consent Decree Adjustment Criteria <sup>2</sup> (µg/L)	Action Level Criteria <sup>3</sup> (µg/L)	June 2017 EPA RSL (µg/L)	Current MCL (µg/L)
1,1,1-TCA	200 (MCL)	200	103 (south) 101 (west)	130	800	200
1,1-Dichloroethene (1,1-DCE)	7 (MCL)	7	4.5	4.55	28	7
1,1-Dichloroethane (1,1-DCA)	4,050 (MAC)	4,050	2,026	2,632	2.8	None
Trichloroethene (TCE)	5 (MCL)	5	3.3	3.25	0.49	5
Tetrachloroethene (PCE)	0.7 (10 <sup>-6</sup> cancer risk)	7	Not applicable	0.5	11	5
Methylene Chloride	2.5 (10 <sup>-6</sup> cancer risk)	25	Not applicable	1.6	11	5

µg/L = micrograms per liter

MAC = maximum acceptable concentrations value, which should not be exceeded in water used for drinking (ingestion) or bathing (dermal) calculated in Risk Assessment and summarized in Table 5 of the 1987 ROD.

<sup>1</sup> Evaluation Criteria were established in the Consent Decree because the available detection limits for PCE and methylene chloride were higher than the Performance Criteria. New analytical methods with lower detection limits are now being used; therefore, the Performance Criteria apply to all of the listed COCs for determining compliance and the Evaluation Criteria provided in the Consent Decree are out of date.

<sup>2</sup> The Adjustment Criteria are calculated in the O&M Manual based on method presented in the Consent Decree (Section V.A.2.a, Table V-1 and Section V.C.2.a). Adjustment Criteria are designed to conservatively evaluate the need for extraction system operational changes and are also used to determine when an extraction well can be put into standby mode. Adjustment Criteria are only used to manage operation of the extraction systems. The termination of the entire remedial action will be complete when the Consent Decree Performance Criteria for groundwater have been met throughout the plume extent.

<sup>3</sup> The Action Level Criteria are defined in the Final Work Plan Groundwater Pump & Treat System Shutdown Test and are set equal to 65 percent of the Performance Criteria and are used to modify sampling frequencies and evaluate the need for system restart during the shutdown test.

1,4-dioxane has been detected at the Site above the Washington State Model Toxics Control Act (MTCA) criterion of 7 µg/L but has not been designated a COC through administrative action. Additionally, EPA has revised the toxicity data for 1,1-DCA. The EPA RSL for 1,1-DCA in tap water is now 2.8 µg/L (June 2017). The Consent Decree Performance Criterion for 1,1-DCA is likely to change in the future to reflect the new toxicity data. For the above reasons, the MTCA criterion of 7 µg/L for 1,4-dioxane and the EPA RSL for 1,1-DCA are referenced in this report when evaluating 1,4-dioxane and 1,1-DCA concentrations and trends.

### 3.3 SELECTED REMEDY

The selected interim remedy included three primary components:

- Groundwater extraction and treatment with a P&T system (see Figure 1)
- Landfill closure in accordance with the Washington State Minimum Functional Standards (MFS), including a landfill gas (LFG) migration control system
- Alternate water supply for affected residents.

The P&T system consisted of the following components:

- West Extraction System – Comprised of three extraction wells (CP-W1 to CP-W3) screened in the lower aquifer, intended to provide hydraulic containment at the western edge of the closed landfill. Extraction well CP-W1, which is located southwest of the closed landfill, was shut down in January 2005 because it achieved low concentrations of target COCs. The remaining two west system extraction wells pumped on the order of 400 to 450 gallons per minute (gpm) combined until the entire extraction remedy was shut down in April 2014.
- East Extraction System – Comprised of three extraction wells (CP-E1 to CP-E3) screened in lower aquifer and/or weathered basalt/Latah, intended to remove groundwater with highest concentrations located near the eastern edge of the closed landfill. CP-E1 and CP-E3 pumped on the order of 225 to 250 gpm combined until the entire extraction remedy was shut down in April 2014. CP-E2 is screened in the basalt and has had a much lower pumping rate (approximately 0.5 to 2 gpm) prior to the shutdown test in April 2014.
- South Extraction System (shut down since June 2004 due to low concentrations) – Comprised of four extraction wells (CP-S1 and CP-S4 to CP-S6) located more than one mile south of the closed landfill, screened in the upper aquifer, and intended to control contaminant migration to the south of those wells. During the 2006 fourth quarter groundwater monitoring event, water from one of the south system extraction wells had a TCE concentration of 3.3 µg/L, which is just over the Adjustment Criteria that is used to determine when wells can be shut off (discussed later). This well was reactivated and ran until January 2007 when concentrations of TCE decreased to below the adjustment criteria. All of the south extraction wells have been on standby since that date.
- Treatment System – The treatment system consists of an air stripper that removes VOCs (volatile organic compounds) from the groundwater. The O&M manual indicates the air stripper can treat up to 1600 gpm, though flow rates prior to system shutdown were lower (approximately 650 gpm). The air stripper has a 50-horsepower blower with a motor controlled by a variable frequency drive, and the RSE report indicates that the stripper operated at approximately 15 Hertz (or approximately 10 horsepower). A scale control chemical (NALCO 8357, shipped from Carson, California) was added to the water at a rate of 20 milliliter diluted solution per 1000 gallons of water (the diluted solution is one part scale inhibitor to seven parts water). There is also a small tank near the air stripper that was intended for use with disinfection chemicals, but those have only been used once. There is no vapor treatment for the stripped VOCs. Treated groundwater is discharged via gravity to the Little Spokane River through an underground 12-inch diameter polyvinyl chloride pipeline.



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## 4.0 FINDINGS

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### 4.1 WORKING CONCEPTUAL SITE MODEL

The optimization team's working CSM based on investigation efforts to date is presented below.

#### 4.1.1 *Primary and Secondary Sources of Contamination*

The original source of contamination was the release of liquid waste to landfill trenches. However, vertical migration of that waste through soil and into groundwater has resulted in subsurface contamination that has served as an ongoing source of dissolved groundwater contamination since the initial release. Estimates of the initial amount of chemical waste released to the landfill are not available.

The 2010 RSE analyzed mass removal from the P&T system and the LFG system. The analysis concluded that P&T system mass removal was initially more than 1,000 pounds of VOCs per month subsequently decreasing to approximately 200 pounds of VOCs per year. The total VOC mass removed by the P&T as of 2009 was over 10,500 pounds. The LFG system has removed significantly less VOC mass. The VOC mass removal in 1996 and 1997 was approximately 38 pounds per year and 21 pounds of per year, respectively. In 2004, which is the year groundwater extraction from the upper aquifer was first discontinued, VOC mass removal was approximately 1 pound per year. The above mass removal rates suggest that VOC mass is not highly concentrated in the vadose and shallow groundwater and has been flushed from the aquifer, removed by the P&T system, or removed by the LFG system. Furthermore, because all extraction since 2004 has been from the lower aquifer, it is reasonable to conclude that the majority of the remaining VOC mass is in deeper saturated zone soil and groundwater.

#### 4.1.2 *Contaminants of Concern*

Table 4 lists the Site COCs. 1,1,1-TCA, TCE, and PCE are likely original contaminants released to the subsurface. 1,1-DCA is a product of 1,1,1-TCA degradation under anaerobic conditions, and 1,1-DCE is a product of spontaneous, abiotic degradation of 1,1,1-TCA. TCE and PCE degrade into cis-1,2-dichloroethene (cDCE) and vinyl chloride under anaerobic conditions but this degradation appears to be relatively limited due to the relatively low and infrequent detections of cDCE and vinyl chloride. Methylene chloride is also a COC at the Site but is routinely not detected above 1 µg/L in groundwater samples since 1995. For this reason, methylene chloride is not discussed further in this report. For the purposes of this evaluation, 1,4-dioxane is also included because it is present at the Site in concentrations above the Washington State MTCA criterion of 7 µg/L.

#### 4.1.3 *Geology and Hydrogeology*

Based on the Phase 1 Engineering Report (Landau, 1991), the geology consists of vertically stratified and laterally discontinuous geologic units derived from glacial material, modified by erosional (and possibly landslide) process, overlaid on granitic bedrock. There are six primary units, which are described below and depicted in cross-sections provided in Appendix B.

The *upper aquifer* is unconfined and consists of a sand and gravel unit that extends from the eastern hills west to the bluffs of the Little Spokane River. Groundwater flow in the upper aquifer is predominantly toward the southwest and south, towards a discharge point well south of the landfill (see potentiometric

surface maps in Appendix B). The fluvial unit associated with the Little Spokane River (west of the landfill) receives some recharge from the upper aquifer, and there are some springs reportedly present on the bluff adjacent to the Little Spokane River. The Phase 1 Engineering Report (1991) stated that pump testing performed at extraction well CP-S1 indicated transmissivity of 10,000 to 12,000 feet<sup>2</sup> per day, and hydraulic conductivity of 530 to 640 feet per day (using approximate saturated thickness of 19 feet). This represents very conductive aquifer material, which helps explain how contaminant mass in shallow groundwater could have been flushed from the system or removed by P&T by 2004.

The *lacustrine unit*, which is located between the upper and lower aquifers is a stratified silt, clay, and fine sand sequence. The lacustrine unit is present beneath much of the landfill and to the west of the landfill. The eastern limit of the lacustrine unit is near the eastern boundary of the landfill.

The *lower aquifer* is confined to the west of the landfill and unconfined to the east of the landfill. To the west of the landfill, the upper and lower aquifers are separated by the lacustrine unit which causes the confined conditions in that area. The lower aquifer consists of sands and gravels. Groundwater flow in the lower aquifer is predominantly toward the west, with discharge to the Little Spokane River (see potentiometric surface maps in Appendix B). The Phase 1 Engineering Report (1991) stated that pump testing performed at extraction well CP-W1 indicated transmissivity of 30,000 to 40,000 feet<sup>2</sup> per day, and hydraulic conductivity of 170 to 230 feet per day (using approximate saturated thickness of 175 feet). The Phase 1 Engineering Report (Landau, 1991) stated that pump testing performed at extraction well CP-E1 indicated transmissivity of 10,000 to 14,000 feet<sup>2</sup> per day, and hydraulic conductivity of 100 to 140 feet per day (using approximate saturated thickness of 100 feet). These values for hydraulic conductivity also represent very conductive aquifer material.

The *Latah Formation and Weathered Latah Formation* consist of fine-grained lacustrine sediments that overlie the granitic bedrock. The Basalt Unit (described below) is interbedded within the Latah formation. The Weathered Latah Formation, where present, overlies the Latah Formation and consists of weathered material derived from the lower Latah Formation and weathered material from the basalt that is contained within the Latah Formation. In some places, the Latah and Weathered Latah Formations are below the lower aquifer, and in other places the lower aquifer is absent and the Latah Formations are below the upper aquifer. Sand lenses are present within the Latah Formation as indicated in the boring log for CD-22 and may be intercepted or screened by nearby domestic supply wells.

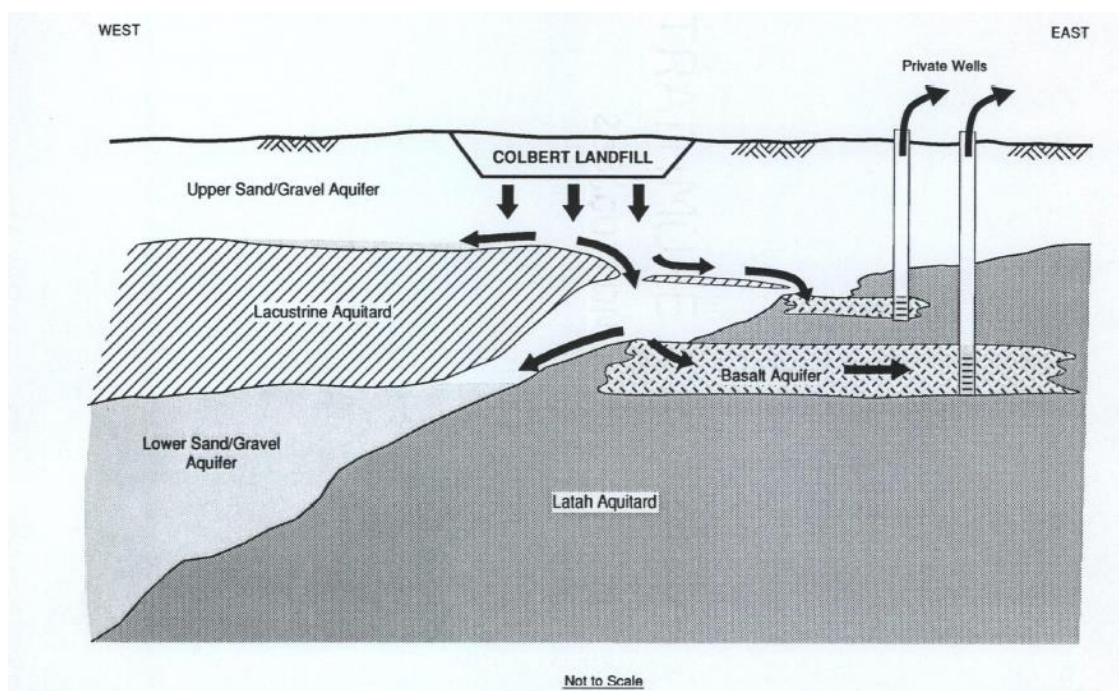
*Basalt* is interbedded within the Latah Formation forming secondary aquifers that appear to be of limited extent. One of the remedy extraction wells (CP-E2) is completed in the basalt. The Phase 1 Engineering Report (1991) stated that pump testing performed at extraction well CP-E2 indicated transmissivity of 25 feet<sup>2</sup> per day, and hydraulic conductivity of 0.7 feet per day (using approximate saturated thickness of 35 feet). These parameter values are much lower than for the upper aquifer and lower aquifer, and limit the rate at which groundwater can be extracted. However, the hydraulic gradient is significantly steeper in the basalt unit than in the upper and lower aquifer, such that the linear groundwater velocity may be as high as 0.4 feet per day (146 feet per year). Contamination detected CP-E2 suggests that COC mass is present this lower permeability unit or the surrounding Latah Formation and may be serving as an ongoing secondary source of contamination to the overlying lower aquifer.

*Granite* represents the bedrock unit. As illustrated on the cross sections in Appendix B, the granite bedrock is several hundred feet below ground surface in the vicinity of the landfill.

The discontinuous nature of the lacustrine unit, the lower aquifer, and the other units (Latah, Weathered Latah, and basalt) makes the hydrogeology extremely complex, and has impacted the contaminant distribution and remedy design.

#### 4.1.4 Contaminant Fate and Transport

Water level measurements and associated potentiometric surface maps from 1989 (prior to remedy groundwater extraction) are provided in Appendix B. Groundwater flow and contaminant transport occurs through sand lenses in the Latah Formation and through fractures in the basalt. This fate mechanism is less well understood due a relatively sparse monitoring network within these formations and the complexity introduced by heterogeneity in the subsurface. Continued extraction from residential wells, which may be significant due to irrigation use, could alter flow directions in the Latah sand lenses or the basalt from the apparent larger-scale groundwater flow directions illustrated in the potentiometric surface maps show in Appendix B. Figure 2 presents a schematic from the Phase 1 Engineering Report (Landau, 1991) that conceptually illustrates potential transport pathways.



**Figure 2:** Schematic of Contaminant Migration in the Various Geologic Units at the Site.

[Excerpted from Phase 1 Engineering Report (Landau, 1991). Reproduced in Appendix B.]

Potentiometric surface maps and groundwater extraction in the area suggest that over time, much of the contaminant mass in the upper aquifer appears to have migrated to the lower aquifer, been extracted by the residential wells or the South Extraction System, or potentially discharged to the surface via springs near the river. Remaining concentrations of the Site COCs in the upper aquifer monitoring wells are below the Consent Decree Performance Criteria except for PCE at CD-60A1 and CP-S4. These exceedances for PCE have changed little since 1999 but are within a factor of 1.5 of the Consent Decree Performance Criterion of 0.7 µg/L and are below the current MCL (5 µg/L) and the June 2017 EPA Regional Screening Level of 11 µg/L. If the cleanup criteria are revisited as part of a final ROD, the PCE concentrations at CD-60A1 and CP-S4 would likely be below the new cleanup criterion for PCE.

As of 2012 (after many years of remedy operation and prior to the shutdown), COC concentrations in the lower aquifer were above the Consent Decree Performance Criteria in several locations as shown in Table 5. These locations are within the landfill footprint and north, west, and south of the landfill.

TABLE 5. Summary of Highest COC Concentrations in Lower Aquifer, 5/2012 (reported 2013)

Well	Concentration (µg/L)					Notes
	1,1,1-TCA	1,1-DCE	1,1-DCA	TCE	PCE	
Criteria	200	7	4,050 (2.8)	5	0.7 (5)	For reference, the EPA RSL is provided for 1,1-DCA and the current MCL is provided for PCE.
Within Landfill Footprint						
CD-04E1	42.1	271	266	13.9	2.17	<b>Formation:</b> Completed in basalt. <b>Location:</b> Near center of landfill <b>Nature of Contamination:</b> Mass from original release within basalt and feeding lower aquifer contamination.
CP-E1	21.8	16.8	7.91	3.58	0.53	<b>Formation:</b> Lower aquifer extraction <b>Location:</b> Along the northern landfill boundary <b>Nature of Contamination:</b> Likely capturing contaminant mass in the lower aquifer that has emanated from basalt and other low permeability material in the source area.
CP-E2	88.2	107	30.6	94.6	0.74	<b>Formation:</b> Extraction well completed in the basalt <b>Location:</b> Southeastern corner of landfill. <b>Nature of Contamination:</b> Mass from original release.
North of Landfill						
CD-01C1	106	46.9	12.6	0.72	<0.5	<b>Formation:</b> Lower aquifer wells <b>Location:</b> North of landfill.
CP-E3	28.4	15	2.71	1.09	<0.5	<b>Nature of Contamination:</b> Contamination potentially emanating from the basalt and influenced by CP-E3 and domestic well operation.
CD-08C1	19.2	37.4	5.08	6.78	<0.5	
West of Landfill						
CP-W2	30.7	19.7	3.89	6.73	<0.5	<b>Formation:</b> Lower aquifer extraction well <b>Location:</b> Northwest of the landfill boundary <b>Nature of Contamination:</b> When operating was extracting contamination from the lower aquifer that had emanated from the source area.
0273L-2	3.62	11.6	2.37	<0.5	<0.5	<b>Formation:</b> Residential well likely screened in a sand lens in the Latah Formation. <b>Location:</b> North and east of the landfill. <b>Nature of Contamination:</b> Contamination that has migrated north of the landfill due to domestic pumping.
South of Landfill						
CD-26	43.8	30.7	12.7	59.3	<0.5	<b>Formation:</b> Monitoring well at the bottom of the lower aquifer near the interface with the Latah Formation. <b>Location:</b> South of the landfill and may be downgradient of a source near the southeastern corner of the landfill. <b>Nature of Contamination:</b> Likely the result of contamination migrating south or southwest from a source near the southeastern corner of the landfill.
CD-23C2	19.9	8.03	0.86	3.31	<0.5	<b>Formation:</b> Monitoring well at the bottom of the lower aquifer near the interface with the Latah Formation. <b>Location:</b> Southeast of the landfill. <b>Nature of Contamination:</b> Contamination may be from a source near the southeastern corner of the landfill. migration toward this well may be influenced by groundwater extraction from residential supply wells.

\*Highlighted cells indicate a value above the performance criteria or the RSL for 1,1-DCA.

Degradation of 1,1,1-TCA to 1,1-DCA or of PCE and TCE to cDCE occurs within the footprint of the landfill where the oxidation-reduction potential (ORP) is low enough to support this pathway. Further degradation of cDCE aerobically may occur beyond the landfill boundaries, but 1,1-DCA is not expected to degrade further beyond the landfill boundaries. 1,1,1-TCA also degrades abiotically through hydrolysis at a predictable rate based primarily on the temperature of the water. Over time, all of the 1,1,1-TCA is expected to degrade to 1,1-DCE. 1,1-DCE is recalcitrant to most degradation processes. The ratio of 1,1-DCE to 1,1,1-TCA provides a general indication of the age of the leading edge of the plume. Because 1,1-DCE has a lower criterion than 1,1,1-TCA and 1,1,1-TCA serves as a source of 1,1-DCE both 1,1-DCE and 1,1,1-TCA concentrations need to be monitored and plotted.

1,4-Dioxane was reportedly sampled from all wells at the Site prior to 2008 and was detected in a limited number of wells at concentrations ranging from 2.2 µg/L to 96 µg/L. The highest concentration (96 µg/L) was detected at CD-04C1 (within the footprint of the landfill) and was qualified as exceeding the calibration range. 1,4-dioxane was one of the stabilizers used for 1,1,1-TCA solvents, typically at concentrations ranging from 3 percent to 8 percent (Doherty, 2000). As a result, 1,4-dioxane concentrations would be approximately 10 to 20 times lower than 1,1,1-TCA at the source area. 1,4-dioxane will not degrade in the subsurface and would likely migrate faster through the subsurface than 1,1,1-TCA and 1,1-DCE due to its limited adsorption to organic carbon in aquifer material. Since 2009, 1,4-dioxane sampling has been limited to CD-40C1 (lower aquifer southwest of the landfill), CP-S1 (upper aquifer south of the landfill), 1073D-1 (upper aquifer southwest of the landfill), and 1473M-1 (upper aquifer south of the landfill). The sampling program has not been expanded since shutdown of the P&T system. 1,4-Dioxane concentrations as high as 7.7 µg/L (exceeding the MTCA criterion of 7 µg/L) continue to be present at CD-40C1, but the current extent of 1,4-dioxane contamination cannot be assessed with the limited current data set.

#### *4.1.5 Remedial System Performance*

The South Extraction System has been successful at remediating the observed dilute VOC plume in the upper aquifer below the Consent Decree Performance Criteria with only a few minor exceptions. The remaining, sporadic exceedances of PCE at CP-S4 and CD-60A1 at concentrations between 0.7 µg/L and 1.12 µg/L are too low, too inconsistent, and too far apart to address with active remediation. The concentrations have changed little since 2002.

Prior to system shutdown in April 2014, the East and West Extraction systems (including those components located north of the landfill) were providing some level of source control and plume migration control. COC concentrations at the compliance wells that were previously above the Consent Decree Performance Criteria at the time of P&T system start-up declined below the Consent Decree Performance Criteria by 2012. However, as indicated in Table 5, several wells outside of the landfill footprint to the west and to the north were above the Consent Decree Performance Criteria in 2012. Therefore, the remedy was either not completely successful at controlling plume migration or did not operate for a sufficient amount of time to allow for aquifer restoration in all areas.

#### *4.1.6 Potential Human and Ecological Exposure Pathways*

The primary potentially complete exposure pathway at this Site is human ingestion and contact with affected groundwater through domestic use. Connection of many residences to municipal water and routine sampling of domestic wells limits human exposures. The potential for vapor intrusion has been previously evaluated and determined to not result in an unacceptable risk. Based on previous studies, ecological receptors are not at risk.



## 4.2 EVALUATION OF SHUTDOWN TEST SAMPLING RESULTS

Effectiveness of the remedy can also be evaluated by the changes in COC concentration trends in response to remedy shutdown. For example, prior to the shutdown test in April 2014, the direction of contaminant migration appeared to be influenced by groundwater extraction from CP-E1, CP-E3, and CP-W2, and the contamination migrated into the area of the CP-W2 capture zone. The extraction of the contaminated groundwater, diluted by other water extracted from CP-W2, resulted in significantly lower detections in CP-W2 than those observed at the CD-04 cluster. In the absence of pumping, the plume no longer migrates toward CP-W2, resulting in a decrease in the observed CP-W2 COC concentrations. The contamination is now migrating more toward CP-W3 and is not diluted by the extraction of clean water because CP-W3 is not operating. Figure 3 depicts this conceptual change in groundwater flow directions.

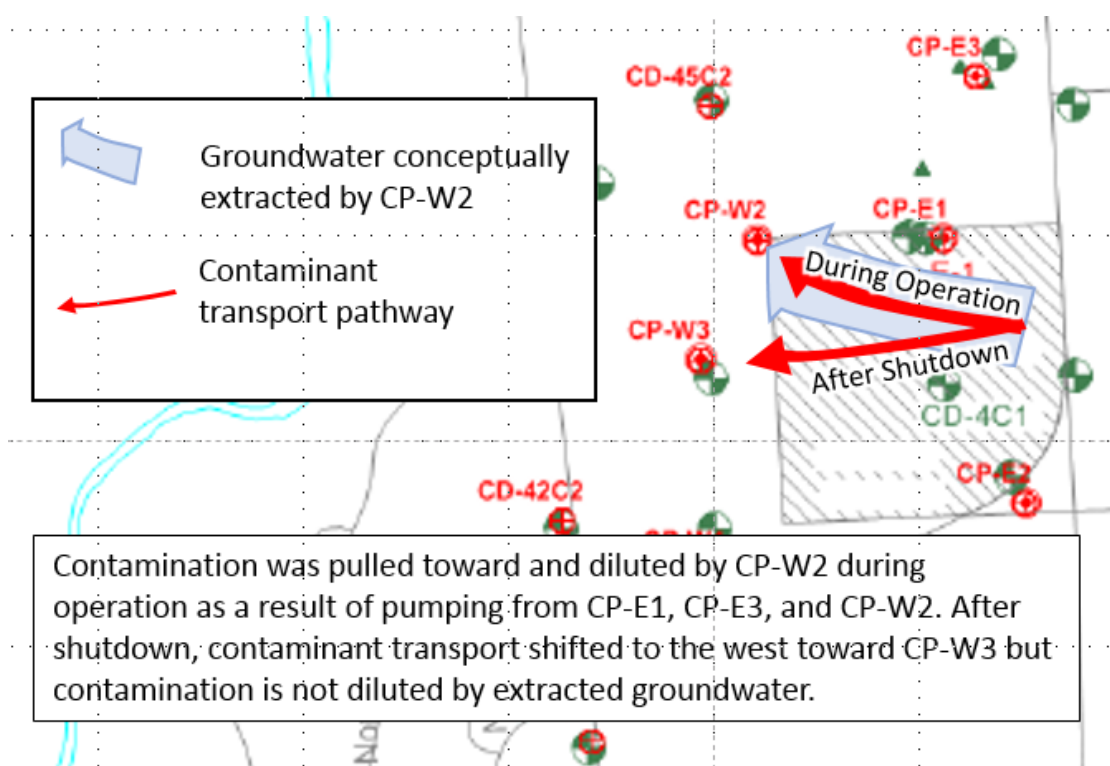
Since operation of the P&T system was discontinued in April 2014, COC concentrations in extraction well CP-W3 have increased substantially as a result of contamination migrating from the CD-04 cluster toward CP-W3. Table 6 summarizes the concentrations at CP-W3, CD-04, and downgradient well CD-49. Tabulated values and trend charts from the annual reports are included in Appendix B. Additional time series plots provided by Spokane County are provided in Appendix C. There are no exceedances of the Consent Decree Performance Criteria at CD-49, but there have been detections with increasing concentrations since remedy extraction was discontinued. Figure 4 presents the 1,1-DCE concentration trends at CP-W3 and CD-49 between April 2014 (system shutdown) and April 2017. The optimization team interprets the non-detect values (plotted as 0.25 µg/L) for CD-49 as potentially resulting from temporary changes in groundwater flow directions slightly north or south of CD-49 or inherent variability in sampling and analysis rather than reductions in contaminant flux migrating from the landfill.

Furthermore, the highest COC detections at CD-49 may be associated with the fringe of the plume rather than with the core of the plume, such that higher concentrations would be migrating past CD-49 to the north or the south. Similar concentration increases of 1,1,1-TCA have been evident at CP-W3 and CD-49. The 1,1,1-TCA concentration was as high as 105 µg/L in January 2017. Although the 1,1,1-TCA concentrations remain below the Action Level of 130 µg/L and the Performance Criterion of 200 µg/L, the migration of 1,1,1-TCA is still of concern because it degrades abiotically into 1,1-DCE, which has a much lower Action Level and Performance Criterion. Concentration increases of 1,1-DCA and TCE are also evident at CP-W3 but are not yet evident at CD-49. The 1,1-DCA concentration at CP-W3 was as high as 42.7 µg/L in January 2017, and the TCE concentration at CP-W3 was as high as 40.2 µg/L in April 2017.

**TABLE 6. Summary of COC Concentrations along CP-W3 Pathway in 5/2012 (7/2014 for CD-49) and 7/2017**

Date	Concentration (µg/L)					Notes
	1,1,1-TCA	1,1-DCE	1,1-DCA	TCE	PCE	
Performance Criteria	200	7	4,050 (2.8)	5	0.7 (5)	EPA RSL and current MCL provided in parentheses for 1,1-DCA and PCE, respectively.
Action Level	130	4.55	2,632	3.25	0.5	Defined in shutdown test work plan
CD-04E1 05/2012	42.1	271	266	13.9	2.17	Relatively unchanged between 2012 and 2017
CD-04E1 04/2017	36.4	326	241	13.4	2.26	
CP-W3: 5/2012	9.7	6.32	1.39	3.78	<0.5	Significant increases between 2012 and 2017
CP-W3: 7/2017	85.2	73.9	35.9	39.5	<0.5	
CD-49: 7/2014	<0.5	<0.5	<0.5	<0.5	<0.5	Notable increases between 2014 and 2017
CD-49: 7/2017	6.98	2.07	0.51	<0.5	<0.5	

\*Highlighted cells indicate a value above one or more of the listed comparison values.

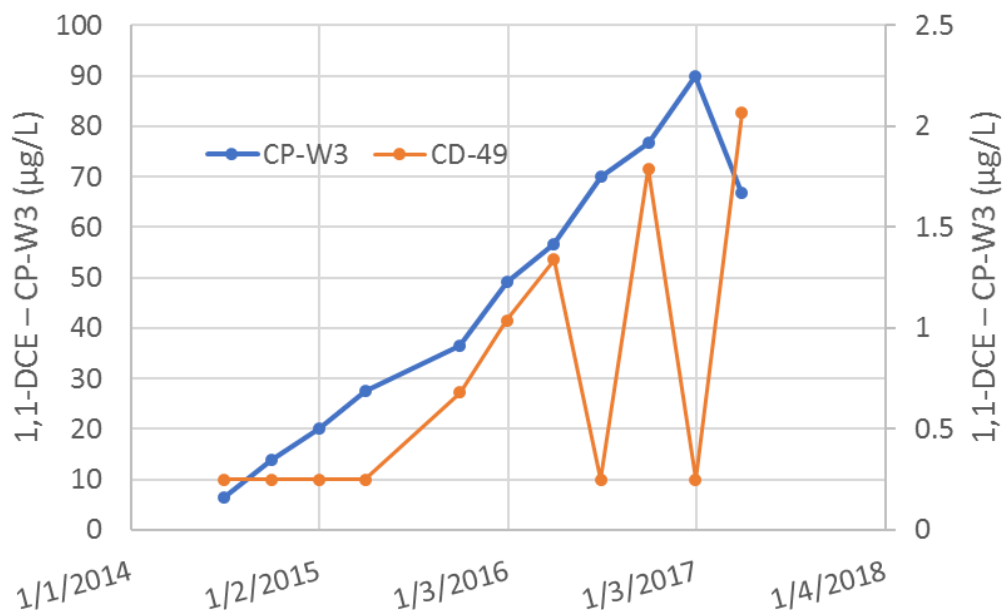


**Figure 3:** Schematic of Contaminant Migration Pathway Change from CP-W2 to CP-W3 as a Result of System Shutdown. [Not reproduced in Appendix B.]

Prior to the shutdown test, it was difficult to determine if there was sufficient contaminant mass migrating from the CD-04 cluster to cause COC concentrations to increase above the Consent Decree Performance Criteria. The shutdown of the extraction system and the resulting concentration increases at CP-W3 confirm that sufficient COC mass flux is occurring beyond the landfill boundary to result in an off-landfill COC plume.

The following notable COC concentration increases also occurred subsequent to remedy shutdown.

- CD-04C1: COC concentration increases by more than an order of magnitude were detected at CD-04C1 between 2012 (when the last sample was collected from this well cluster during system operation) and 2017 (when the first sample was collected subsequent to system shutdown). CD-04C1 is a lower aquifer well that is co-located with basalt well CD-04E1. Spokane County indicates, however, that this apparent increase may be the result of laboratory error.



**Figure 4:** 1,1-DCE Concentration Trends at CP-W3 and CD-49. CD-49 non-detect values are plotted as one half of the detection limit (0.25 µg/L). Similar increasing trends for 1,1,1-TCA are evident at CP-W3 and CD-49, and increasing trends for 1,1-DCA and TCE are evident at CP-W3 but not yet at CD-49. These other trends are not plotted to maintain clarity of the plot [Figure not reproduced in Appendix B.]

- CP-W1: The 1,1-DCE concentration increased from 1.29 µg/L prior to system shutdown to approximately 4 to 6 µg/L in 2017. As of July 2017, the 1,1-DCE concentration at this well is above the Action Level but below the Consent Decree Performance Criterion. The 1,1,1-TCA concentration also had a similar increase during this time period. 1,1-DCA, TCE, and PCE continue to be undetectable in samples collected from this well.
- CD-24C2/CD-21C1/CP-E1: 1,1-DCE, 1,1,1-TCA, and TCE concentrations increased in this area. As of April 2017 (last available sampling round for the monitoring wells), the 1,1-DCE concentration remains below the Consent Decree Performance Criterion but above the Action Level. The TCE concentration has increased from 3.58 µg/L in 2012 to 7.48 µg/L in July 2017 (last available sampling round for the CP-E1), which is above both the Action Level and the Consent Decree Performance Criterion. The 2017 1,1-DCA concentration for CP-E1 is 10.3 µg/L, which is over the EPA RSL value of 2.8 µg/L.

These COC increases further exemplify the change in contaminant migration pathways resulting from the shutdown of the P&T system and provide an indication of the magnitude of contamination that can migrate off-site in the absence of remedy pumping. Other concentration increases may also be present, but the current organization and presentation of the data in multiple reports, without detailed trend charts and complete historical data tables for all parameters and monitoring locations makes it difficult to provide a thorough review of all potential concentration increases.



### 4.3 IDENTIFICATION OF DATA GAPS

The optimization team has identified the following data gaps that are critical to address for eventual remedy success.

- The locations and depths of the source areas (including the distribution of substantial contaminant mass in lower permeability materials) within, potentially extending outside of the landfill footprint, have not been identified. Although the exact source locations do not need to be known, the nature, extent, and general location need to be sufficiently understood as discussed in the following paragraphs to ensure a source area remedy or source control strategy can be effectively implemented.

The source of contamination at CD-26 is poorly understood. Based on the depicted groundwater flow directions in Site potentiometric surface maps, it appears that the source may be located off landfill property. Groundwater extraction from CP-E2 has been low and insufficient to control this source, resulting in COC concentrations exceeding Consent Decree Performance Criteria for approximately 20 years after remedy implementation. It is also possible that the source of contamination identified at CD-26 is located within the landfill property and that the groundwater flow direction is poorly understood. Better identification of the source and hydrogeology can lead to better source control.

The source of contamination extracted by CP-E3 prior to the shutdown test is also not adequately controlled within the landfill property. Groundwater extraction from CP-E1 should be sufficient to control this source if it is migrating through the lower aquifer from the landfill to CP-E3. However, over a 20-year period, with extraction from CP-E1, contamination is still migrating past the landfill boundary to be extracted by CP-E3. The failure of CP-E1 to provide source control along this area of the landfill boundary may be due to a lack of understanding of the source location and groundwater flow directions.

The source of the contamination observed at the CD-04 monitoring wells is also poorly understood. The concentration trends discussed in Section 4.2 suggest that the contamination was historically captured by CP-W2 but is now migrating past CP-W3. Better identification of the source could improve source control.

There may be other areas with insufficient source characterization, but the areas described above are the most evident from a review of the data as presented in the Site reports.

- Uncertainty in groundwater flow directions may add to the difficulty in locating and controlling contaminant sources. Part of this uncertainty is due to the complexity of the geology and the relatively sparse well gauging network. For example, despite the persistent elevated COC concentrations at CD-26, there are no piezometers or monitoring wells to the north (between CD-26 and southeastern corner of the landfill where elevated COC concentrations are present). The closest monitoring well to the northwest (CD-02R2) is over 1,000 feet away, and the closest monitoring well to the northeast (CD-22D1) is over 2,000 feet away. The lack of water level data in this area makes it difficult to reasonably interpret groundwater flow directions, identify the contaminant transport pathway, and evaluate the effect of remedy pumping. The saturated thickness in the lower aquifer is very thin in this location, and it is possible that groundwater flow is controlled by the contour of the surface of the Latah Formation.
- The mechanism for contaminant transport to wells such as 273L-2 and CD-23C2 is unclear. These wells appear to be located upgradient from sources within the landfill. Potential transport mechanisms could include poorly characterized, localized, groundwater flow directions that differ

from generalized regional flow interpretations. Substantial groundwater extraction from remaining private water supply wells used for irrigation may cause localized or seasonal changes in groundwater flow. Although domestic water use from the thick portion of the lower aquifer would be unlikely to significantly alter groundwater flow directions, domestic water use from the basalt, sand lenses within the Latah Formation, or from the thin portion of the lower aquifer could affect groundwater flow direction in those units.

- The distribution of 1,4-dioxane in groundwater subsequent to system shutdown is uncertain. Previous comprehensive 1,4-dioxane sampling was conducted after years of remedy operation. However, now that the system has been turned off, it is unclear if residual 1,4-dioxane is migrating off Site.
- The Colbert Landfill received wastes from FAFB that were subsequently labeled as hazardous. In addition, groundwater near the FAFB has been found to contain per- and polyfluoroalkyl substances (PFAS), likely associated with the use of aqueous film forming foam (AFFF) containing PFAS. It is not known whether any of the FAFB wastes disposed of at the landfill may have included any PFAS containing materials.
- The migration pathway of the plume core and the total width of the plume currently detected at CP-W3 are both uncertain. The plume core may be migrating north or south of CP-W3, with only the plume fringe detected at CP-W3.

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## 5.0 RECOMMENDATIONS

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Site-specific recommendations are provided for the five major areas associated with optimization: remedy effectiveness, cost reduction, technical improvement, progress toward site closure, and environmental footprint reduction. Table 7 provides a summary of the recommendations and estimated costs/ savings for implementing each recommendation. The levels of certainty for the cost estimates provided are comparable to those typically prepared for CERCLA Feasibility Study reports (-30 to +50 percent), and are considered rough estimates for planning purposes.

### 5.1 RESTART CP-W3

The West Extraction System is intended to capture contamination from the landfill area to prevent further plume migration and promote aquifer restoration. Presumably, site-specific constraints required that the West Extraction System wells were installed off-site. Additionally, the compliance monitoring wells were located further from the landfill so that they would be located outside of the West Extraction System capture zone.

Although the existing compliance monitoring wells for the West Extraction system may be appropriate for confirming plume capture and remedy performance during active extraction, they are over 1,000 feet from the landfill boundary. In the absence of extraction from the West system, these wells are not appropriate compliance monitoring points. In the absence of remedy groundwater extraction, compliance monitoring wells should be located at or much closer to the boundary of the waste. CP-W3, which is located approximately 200 to 300 feet downgradient of the landfill, would be a reasonable compliance monitoring point when it is not actively extracting groundwater.

Concentrations at CP-W3 have increased more than an order of magnitude above the Consent Decree Performance Criteria since the shutdown test began. The elevated COC concentrations at CP-W3 combined with the groundwater flow rate in that area suggests ongoing contaminant migration will impact downgradient portions of the aquifer in the near future, if it has not already. This contaminant migration, combined with the sparse monitoring network (several hundred feet between compliance monitoring locations) and a relatively flat hydraulic gradient make it difficult to specifically determine where the plume is migrating. The increasing COC concentrations at CD-49 indicate that contamination is migrating further off-site, but CD-49 is not necessarily within the plume core, and COC concentrations may be higher (and potentially above the Consent Decree Performance Criteria) to the north or south of CD-49. There is approximately 400 feet between CD-49 and the CD-43 cluster and approximately 700 feet between CD-49 and the CD-42 cluster.

Based on above discussion, the optimization team recommends immediately restarting CP-W3 for continuous operation at its maximum reliable flow rate. Restart of this well will help capture contamination that is currently migrating along this pathway. Restarting CP-W1, CP-W2, CP-E1, and CP-E3 is not recommended at this time because operation of these other extraction wells will influence the flow path of the contamination toward CP-W3, and potentially compromise the capture that CP-W3 can provide. The optimization team also recommends restarting CP-E2 because the extraction rate is sufficiently low that it should not affect groundwater flow directions in the lower aquifer and because it is providing some degree of source control and mass removal.

Once CP-W3 is operating, the COC concentrations in CP-W3 are anticipated to decrease due to dilution from other extracted water. These lower concentrations should not be misconstrued as aquifer restoration or source control, and CP-W3 should remain in operation until the source is sufficiently controlled, remediated, or attenuated based on upgradient monitoring, such as at CD-04C1 and CD-04E1. COC concentrations at CD-49 may continue to increase for a short period of time due to the contamination that has already migrated past CP-W3. It is not practical to address the mass that has already migrated past CP-W3, but this continued increase at CD-49 underscores the importance of restarting the CP-W3 immediately.

The optimization team recognizes that restarting CP-W3 is not consistent with the EPA approved Final Work Plan Groundwater Pump & Treat System Shutdown Test (Landau, 2013); however, the optimization team believes that consideration of sampling results only from specified “compliance” monitoring wells (rather than other monitoring points, such as CP-W3) for evaluating the potential to resume system operation is flawed and allows for unacceptable contaminant migration beyond the landfill boundary in a complex aquifer system that is used for drinking water. The approach outlined here by the optimization team provides a higher level of protection during system operation and also better positions the Site for eventual Site closure. The optimization team cautions, however, that this approach to operating only CP-W3 and CP-E2 is not intended as a permanent or final remedial approach. It is recommended as a temporary measure to be implemented as a more comprehensive solution is developed that considers the recommendations provided below.

The optimization team estimates that annual costs for system operation might be on the order of \$50,000 per year.

## **5.2 IMPROVE PLUME DELINEATION NEAR CP-W3**

Cross-gradient (north/south) delineation of the plume to be captured by CP-W3 is currently provided by CP-W1 (which is co-located with monitoring well cluster CD-47) approximately 800 feet to the south and CP-W2 (approximately 500 feet to the north). CD-46 is co-located with CP-W3 and therefore does not help with horizontal delineation. The 1,300-foot space between CP-W1 and CP-W2 is likely wider than the CP-W3 capture zone. Therefore, without further delineation, there is no certainty that the entire plume migrating between CP-W1 and CP-W2 will be captured. It is likely, however, that the plume is significantly narrower than 1,300 feet, and with further delineation, it may be possible to determine that a significantly lower extraction rate from CP-W3 can provide the necessary capture.

The optimization team recommends installing additional monitoring wells north and south of CP-W3 to refine plume delineation in this area. The monitoring wells can be screened at the same depth interval as CP-W3. One well should be located 200 feet to the north of CP-W3, and the other should be located 200 feet to the south. Sample results from these new monitoring wells and from CP-W1, CP-W2, and CP-W3 can be used to adequately interpolate the plume width and inform future adjustments to the CP-W3 extraction rate. The new wells can be used as monitoring locations after active remediation ends. The optimization team estimates that the costs for installing and sampling these wells will be approximately \$100,000.

An additional monitoring well at the western boundary of the landfill in line with the CD-04 wells and CP-W3 could be installed and sampled to evaluate when CP-W3 can be shut down. Sampling of this new well could reduce the amount of time that CP-W3 needs to operate because there is likely some attenuation that occurs between the CD-04 wells and the landfill boundary. CP-W3 could be shut down when COC concentrations in this new well reach the Action Levels, which may be earlier than when the

CD-04 wells meet the Consent Decree Performance Criteria. Determining shutdown based on concentrations at an operating extraction well is not recommended because the concentrations are somewhat diluted by cleaner water that is extracted along with the plume. Installation of this additional well might cost an additional \$50,000. Adding this well to an annual monitoring program would likely increase monitoring and reporting costs by less than \$1,000 per year.

### **5.3 CONDUCT ANNUAL SAMPLING OF 12 SUPPLEMENTAL MONITORING WELLS**

The 2012 COC exceedances of the Consent Decree Performance Criteria summarized in Table 5 highlight the critical nature of the supplemental monitoring program, particularly since many of these exceedances were repeated in the April 2017 monitoring event. COC concentrations at CD-01C1/CD-08E1/CP-E3 and CD-26 are of particular concern.

The contamination at CD-01C1/CD-08E1/CP-E3 was likely controlled by the operation of CP-E3 but is no longer addressed in the absence of active extraction. If migration from the landfill was occurring through the lower aquifer, groundwater extraction at CP-E1 should have also prevented contaminant migration to the CP-E3 location. Section 5.4 provides additional suggestions about addressing the contamination detected at CP-E3.

The contamination at CD-26 has never been effectively addressed by the remedy and needs to be monitored and evaluated until an appropriate remedy for this contamination can be identified. The contamination at CD-26 likely dilutes once the thin layer of contaminated water at CD-26 merges with the thicker portion of the lower aquifer. However, the well network surrounding CD-26 provides insufficient information to confirm this. Monitoring concentrations at CP-26 and addressing it (see Section 5.4) will help eliminate the need for further characterization in this area.

Based on the above discussion, the optimization team recommends annual sampling of the 12 supplemental program monitoring wells that had detections of 1,1-DCE in April 2017. These wells also have detections of other COCs and represent key locations to track potential future exceedances or progress toward aquifer restoration. The optimization team estimates that this sampling will cost under \$10,000 per year.

The residential monitoring program should also continue in its current form.

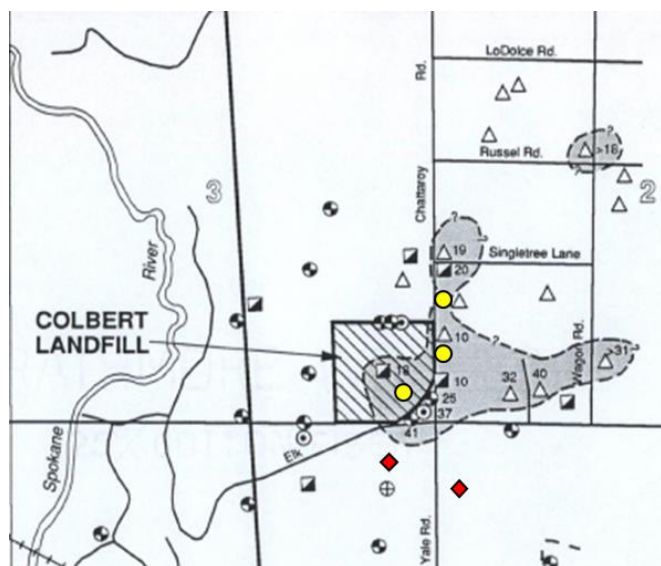
### **5.4 IMPROVE CHARACTERIZATION OF BASALT AND LATAH FORMATION NEAR CD-08, CD-04, AND CP-E2**

Wells screened in the basalt currently have the highest COC concentrations of any of the sampling results, suggesting that the basalt or the surrounding Latah Formation contains the majority of residual contaminant mass and is serving as a source of contamination to the lower aquifer. Sufficiently controlling this secondary source of contamination could provide more reliable plume migration control and potentially lead to permanently shutting down CP-W3. The basalt coupled with supply well extraction from within the basalt may also provide the pathway for northern contaminant migration toward CP-E3. Potentiometric surface maps of the lower aquifer from before, during, and after system operation do not suggest potential migration from the landfill toward CP-E3. The basalt, potentially influenced by groundwater extraction from within the basalt for domestic water use, may help explain the northerly contaminant migration. In addition, contamination in the basalt near CP-E2 that is discharging to the thinly saturated zone of the lower aquifer in this area may be contributing to the contamination observed at CD-23C2 and CD-26. Therefore, by further characterizing and potentially focusing

remediation on the basalt may address the high concentrations that are observed at the landfill (in CD-04 and CP-E2) and the persistent COC exceedances outside of the landfill boundary at CD-23C2, CD-26, and CD-01C1/CD-08E1/CP-E3.

To conduct this characterization, the optimization team recommends installing three additional basalt monitoring wells as depicted in Figure 5. (Figure 5 also includes proposed monitoring well locations for characterization proposed in Section 5.5). In addition to installing these monitoring wells, the optimization team recommends conducting aquifer testing on CP-E2, CP-04E1, and CD-08E1. The purpose of the aquifer testing is to evaluate potential hydraulic connections throughout the basalt, evaluate contaminant concentrations under sustained pumping, and gather information that could inform groundwater extraction or a future in situ remedy within the basalt.

The aquifer testing should be extensive to sufficiently stress the basalt. Water levels should be measured continuously with transducers in CD-04C1, CD-04E1, CD-07E1, CD-08E1, CP-E2, and the three new monitoring wells for one week prior to pumping, during pumping, and during recovery for each of the three wells undergoing testing. Each of the aquifer test wells should be pumped for a minimum of 120-hours and allowed to recover for one week prior to testing the next well. Assuming the extracted water can be contained and treated by the water treatment plant, the optimization team estimates that implementing this recommendation could cost \$300,000, including planning, well installation, testing, and reporting.



**Figure 5:** Suggested locations for three new basalt monitoring wells (yellow circles) plus two new lower aquifer monitoring wells described in Section 5.5 (red diamonds). [Base Map from Landau, 1991 indicating extent of the basalt. Figure 5 not reproduced in Appendix B.]

Data collected as a result of this recommendation should be used to select or optimize a remedy that focuses on the contamination in the Latah Formation and basalt. The remedy could involve additional groundwater extraction or potential application of in situ bioremediation.

## **5.5 IMPROVE CHARACTERIZATION IN THE AREA BETWEEN THE LANDFILL AND CD-26/CD-23C2**

To date, the remedy has been ineffective at preventing plume migration toward CD-26. Extraction at CP-E2 has removed mass but has not been effective at controlling source migration. Two additional lower aquifer monitoring wells, as shown in Figure 5, are recommended to better understand groundwater flow directions and contaminant migration pathways from the southeastern corner of the landfill to CD-26.

This information is anticipated to support design and implementation of a remedy that can provide the needed capture. The lower aquifer has a very thin saturated thickness in this area. The monitoring wells may need to partially screen the lower aquifer and Latah Formation. Groundwater may be flowing along the top of the Latah Formation as appears to be the case at CD-26. When drilling, the borehole should extend into the Latah Formation to determine if the basalt is present. If the basalt is present, then basalt monitoring wells may also be needed. The optimization team estimates that the cost for installing two wells and sampling them is approximately \$100,000.

## **5.6 CONDUCT 1,4-DIOXANE SAMPLING AT LOWER AQUIFER EXTRACTION WELLS, COMPLIANCE WELLS, 12 SUPPLEMENTAL WELLS, AND RESIDENTIAL WELLS**

Due to the lack of plume capture and the change in the groundwater flow directions, the lower aquifer extraction wells, the compliance wells, and the 12 supplemental monitoring program wells identified in Section 5.3 should be sampled and analyzed for 1,4-dioxane. The optimization team recommends a minimum of two sampling events. Wells where 1,4-dioxane exceeds the MTCA criterion of 7 µg/L should be included in the routine monitoring Site monitoring program. The optimization team estimates that this recommendation may cost approximately \$15,000 in additional laboratory analytical costs.

## **5.7 CONDUCT PFAS SAMPLING AT SELECT UPPER AND LOWER AQUIFER WELLS**

EPA's understanding of the distribution and persistence of PFAS in groundwater and the human health risks associated with very low levels of exposure continues to expand. Since the landfill received wastes from FAFB that were subsequently labeled as hazardous and since AFFF containing PFAS were used at FAFB, the optimization team recommends that the same wells identified in Section 5.5 be sampled and analyzed for PFAS to confirm whether PFAS are present in groundwater at the Site. While PFAS are not currently listed as COCs for the Site and sampling may not be required at this time, the optimization team recommends that one round of sampling for PFAS occur within a year. This proactive round sampling will either help confirm PFAS are not present at the Site above the EPA lifetime health advisory limit or will help start a process that will ultimately be needed to prevent further migration and potential exposure. It is recommended that sampling be consistent with EPA's most recent guidance for PFAS sampling. The optimization team estimates that the cost for this sampling, analysis, and reporting would be approximately \$45,000.

## **5.8 REVIEW TOXICITY DATA IN THE NEXT FIVE-YEAR REVIEW AND FINAL ROD**

During the next Five-Year Review, the available toxicity data for 1,1-DCA (as well as emerging contaminants PFAS and 1,4-dioxane) should be reviewed and the criteria based on the updated toxicity information should be used when evaluating the remedy.

Furthermore, as part of updating the CSM and preparing a final ROD, the Site team should consider adding 1,4-dioxane as a COC, updating the toxicity value for 1,1-DCA, and updating the criteria for PCE. These and potentially other adjustments to the COC list and criteria could affect remedy selection and remedy attainment decisions.

## **5.9 IMPROVE REPORTING**

Annual reports summarizing monitoring results could be improved by implementing following changes:

- Post the water levels at each well on the potentiometric surface map. On all plan view figures, include a north arrow and a distance indicator (scale bar).
- Post the COC concentrations and draw iso-concentration contours on plan view maps of the groundwater plumes.
- Include plan view maps of the plumes for all COCs that have one or more exceedances of the Consent Decree Performance Criteria plus 1,1,1-TCA because abiotic degradation of 1,1,1-TCA serves as a source of 1,1-DCE.
- Include tables in an appendix to the report with all historical data from the wells. Presently, a reader needs to refer to several reports just to evaluate tabulated values over a three-year period.
- In plume map figures, highlight or otherwise indicate those wells in which older data were used to draw the plume.
- Include a well construction table.
- Include cross-sections for primary contaminant migration pathways.
- Use tri-lateral diagrams for 1,1,1-TCA, 1,1-DCA, and 1,1-DCE to evaluate COC signatures and, perhaps, provide additional information on the location of the sources. Additional information on this type of analysis is provided in Appendix D.

These suggestions should not significantly increase reporting costs.

## **5.10 REDUCE UPPER AQUIFER MONITORING**

The upper aquifer is generally restored to the Consent Decree Performance Criteria with minor exceptions for PCE at CD-60A1 and CP-S4. If the current PCE MCL or EPA RSL are used in revising the cleanup criterion for PCE in the final ROD, the PCE concentrations at these two wells would be below the new criterion. The upper aquifer monitoring program could be reduced to a frequency of once every five years at the wells sampled in April 2017. Sampling would therefore go from quarterly at the extraction wells to once every five years and from annual at the monitoring wells to once every five years. The optimization team estimates that this reduction may result in a savings of approximately \$10,000 per year but will provide ample information to continue to track progress in the upper aquifer while the lower aquifer is restored.



If all COCs consistently meet the Consent Decree Performance Criteria or criteria adjusted based on updated toxicity information, sampling in accordance with EPA site attainment demonstration guidance should be conducted (EPA 2014). When conditions are met, the sampling frequency for all parameters and locations (including the upper aquifer sampling mentioned in the previous paragraph) will need to change to be consistent with closure guidance.

The optimization team did not use the MFS sampling for evaluating site conditions and therefore suggests that the MFS sampling continue in accordance with the MFS guidance.

TABLE 7. Recommendations and Cost Summary

RECOMMENDATION		EFFECTIVENESS	COST REDUCTION	TECHNICAL IMPROVEMENT	SITE CLOSURE	ENVIRONMENTAL FOOTPRINT REDUCTION	ESTIMATED CAPITAL COST	CHANGE IN ANNUAL COST
5.1	Restart CP-W3	X			X			\$50,000
5.2	Improve plume delineation near CP-W3	X			X		\$150,000	\$1,000
5.3	Conduct annual sampling of 12 supplemental monitoring wells	X			X			\$10,000
5.4	Improve characterization of basalt and Latah Formation near CD-08, CD-04, and CP-E2	X			X		\$300,000	
5.5	Characterize area between Landfill and CD-26/CD-23C2	X			X		\$100,000	
5.6	Sample for 1,4-dioxane at lower aquifer extraction wells, compliance wells and 12 supplemental wells	X			X		\$15,000	
5.7	Sample for PFAS at select upper and lower aquifer wells	X			X		\$45,000	
5.8	Update COCs in the Five-Year Review and Final ROD	X			X		Not estimated	
5.9	Improve reporting	X			X		Not estimated	
5.10	Reduce monitoring in the upper aquifer		X					(\$10,000)

*"X" Indicates that the recommendation pertains to the indicated optimization category*

*Values in parentheses "()" indicate estimated annual cost savings*

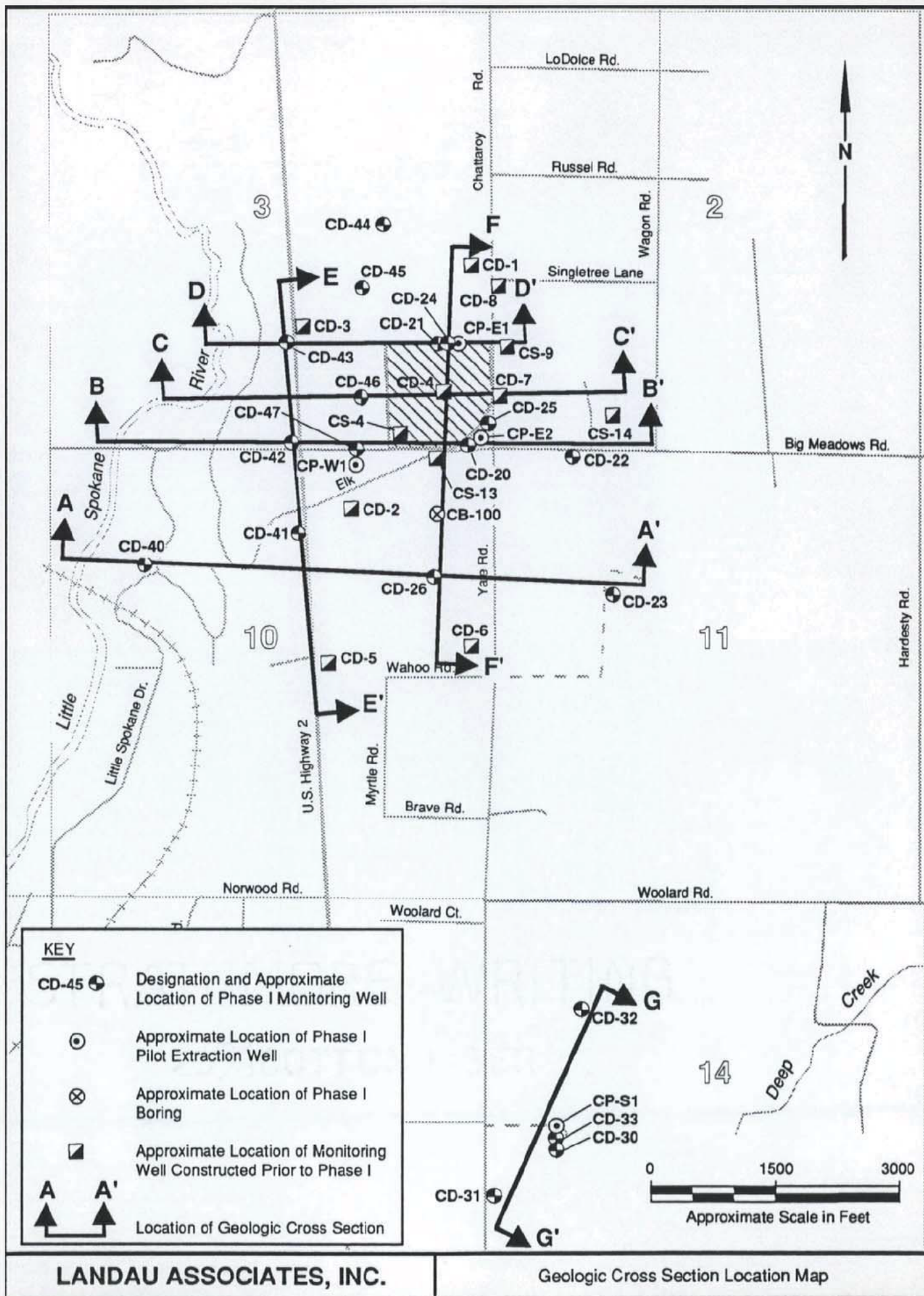
## APPENDIX A:

### REFERENCES

- Doherty, R.E., A History of the Production and Use of Carbon Tetrachloride, Tetrachloroethylene, Trichloroethylene and 1,1,1-Trichloroethane in the United States: Part 2 – Trichloroethylene and 1,1,1-Trichloroethane, *Journal of Environmental Forensics*, 1, 83-93, 2000.
- EPA, *Record of Decision Colbert Landfill Superfund Site*, 1987
- EPA, *Fourth Five-Year Review for Colbert Landfill Superfund Site*, September 30, 2009.
- EPA, *Recommended Approach for Evaluating Completion of Groundwater Restoration Remedial Actions at a Groundwater Monitoring Well*, U.S. Environmental Protection Agency. 2014
- GeoTrans, Inc., *Remediation System Evaluation, Colbert Landfill Superfund Site*, April 13, 2010.
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- Landau Associates, Inc., *Final Extraction Well Plan, Colbert Landfill Remedial Design/Remedial Action*, August 7, 1992.
- Landau Associates, Inc. *Final Work Plan Groundwater Pump & Treat System Shutdown Test*, August 2013.
- Spokane County Landfill Closure, *Colbert Landfill Remediation Project Annual Report 2015*, 2015
- Spokane County Landfill Closure, *Colbert Landfill Remediation Project Annual Report 2016*, 2016
- Spokane County Landfill Closure, *Colbert Landfill Remediation Project Annual Report 2017*, July 13, 2017
- Spokane County, *Third Five-Year Review for Colbert Landfill Superfund Site*, September 20, 2004.
- USACE, *Fifth Five-Year Review for Colbert Landfill Superfund Site*, September 29, 2014.
- Spokane County, *Colbert Landfill Quarterly Progress Report, Second Quarter 2012*, 2011.

## **APPENDIX B:**

### **SUPPORTING FIGURES FROM EXISTING DOCUMENTS**

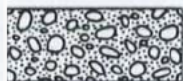




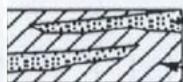
## KEY TO GEOLOGIC CROSS SECTIONS



Fluvial sands, silts and gravels



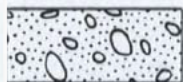
Upper Sand/Gravel Unit (Unit A), composed of gravelly, fine to coarse sand



Sand

Silt/Clay

Lacustrine Unit (Unit B), composed of silt and clay with interbedded fine sand



Lower Sand/Gravel Unit (Unit C), composed of gravelly, fine to coarse sand



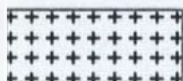
Weathered Latah Subunit (Unit D<sub>1</sub>), composed of gravelly (basalt) silt and clayey silt



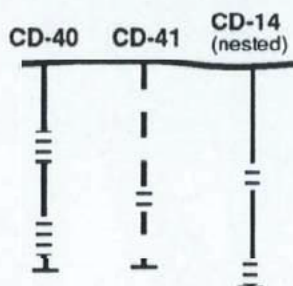
Latah Formation (Unit D), composed of silt, clayey silt and fine sand



Basalt Unit (Unit E), composed of highly fractured to massive Basalt rock



Granite Unit (Unit F), composed of Pre-Tertiary granitic rock, highly weathered with zones encountered during Phase I



Approximate location and number of monitoring well cluster, with screen intervals shown for individual monitoring wells. Projected boring logs have dashed lines. Nested wells are noted, and screen intervals shown.

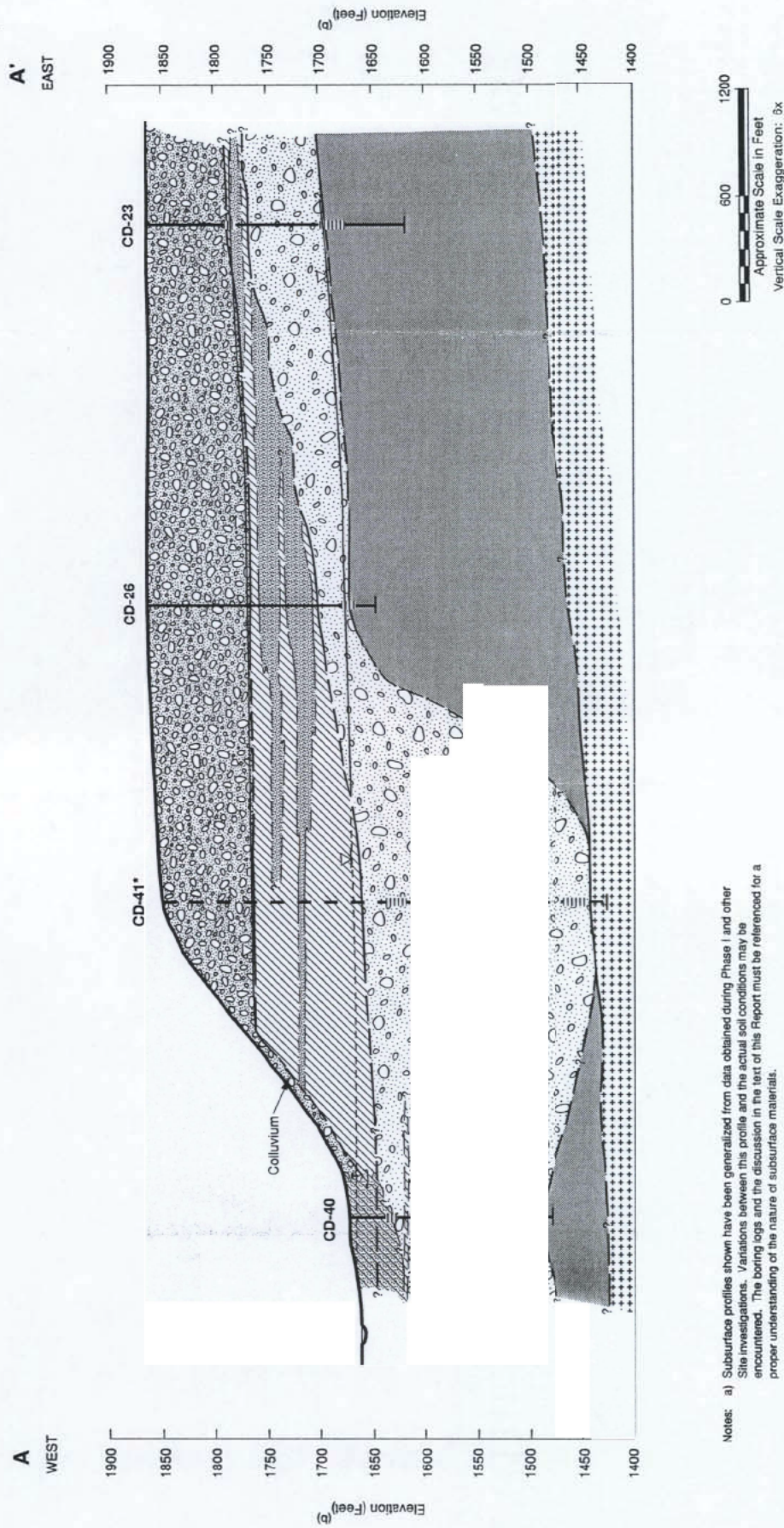


Ground water elevation line, dashed when representing a piezometric surface in a confined aquifer



Contact between stratigraphic units; question marks indicate contact projection based on limited data





Notes:

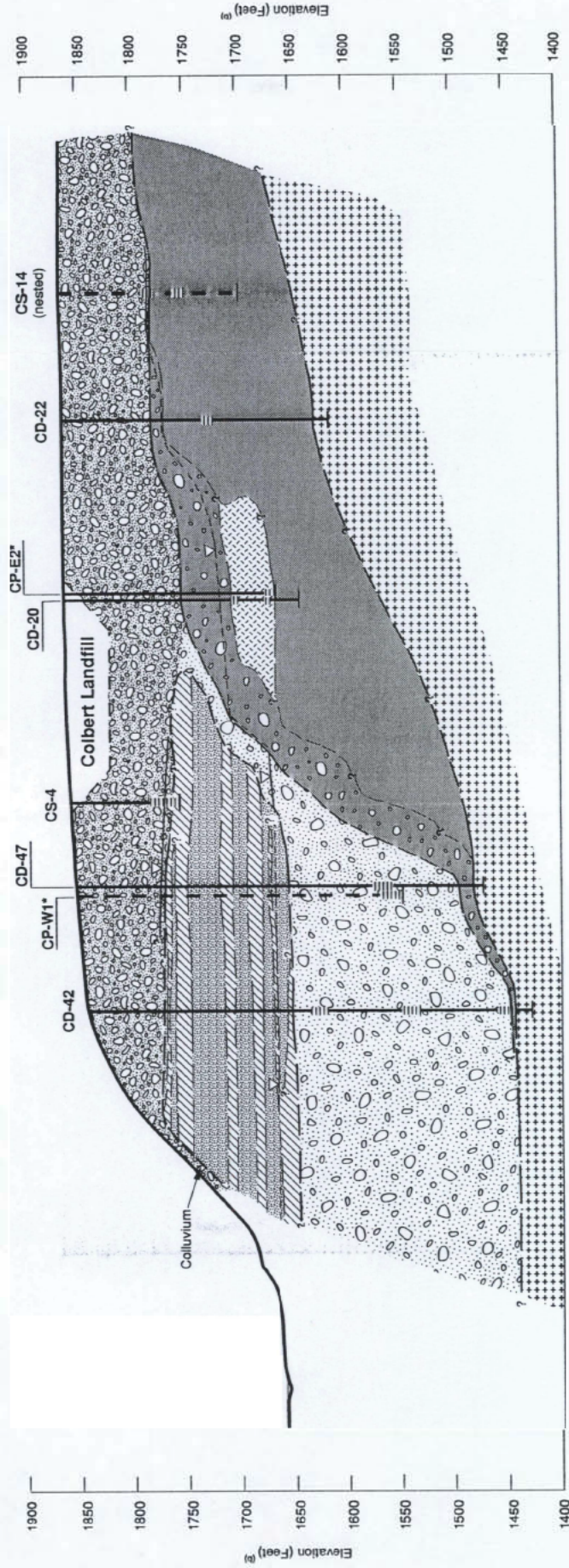
- a) Subsurface profiles shown have been generalized from data obtained during Phase I and other site investigations. Variations between this profile and the actual soil conditions may be encountered. The boring logs and the discussion in the text of this Report must be referenced for a proper understanding of the nature of subsurface materials.
- b) All elevations in feet above mean sea level (MSL) based on 1923 National Geodetic Vertical Datum.

\* Well drilled by air rotary; detailed geology not identified in Lacustrine Aquitard Unit.



B  
WEST

B'  
EAST



- Notes:
- a) Subsurface profiles shown have been generalized from data obtained during Phase I and other Site investigations. Variations between this profile and the actual soil conditions may be encountered. The boring logs and the discussion in the text of this Report must be referenced for a proper understanding of the nature of subsurface materials.
  - b) All elevations in feet above mean sea level (MSL) based on 1929 National Geodetic Vertical Datum.

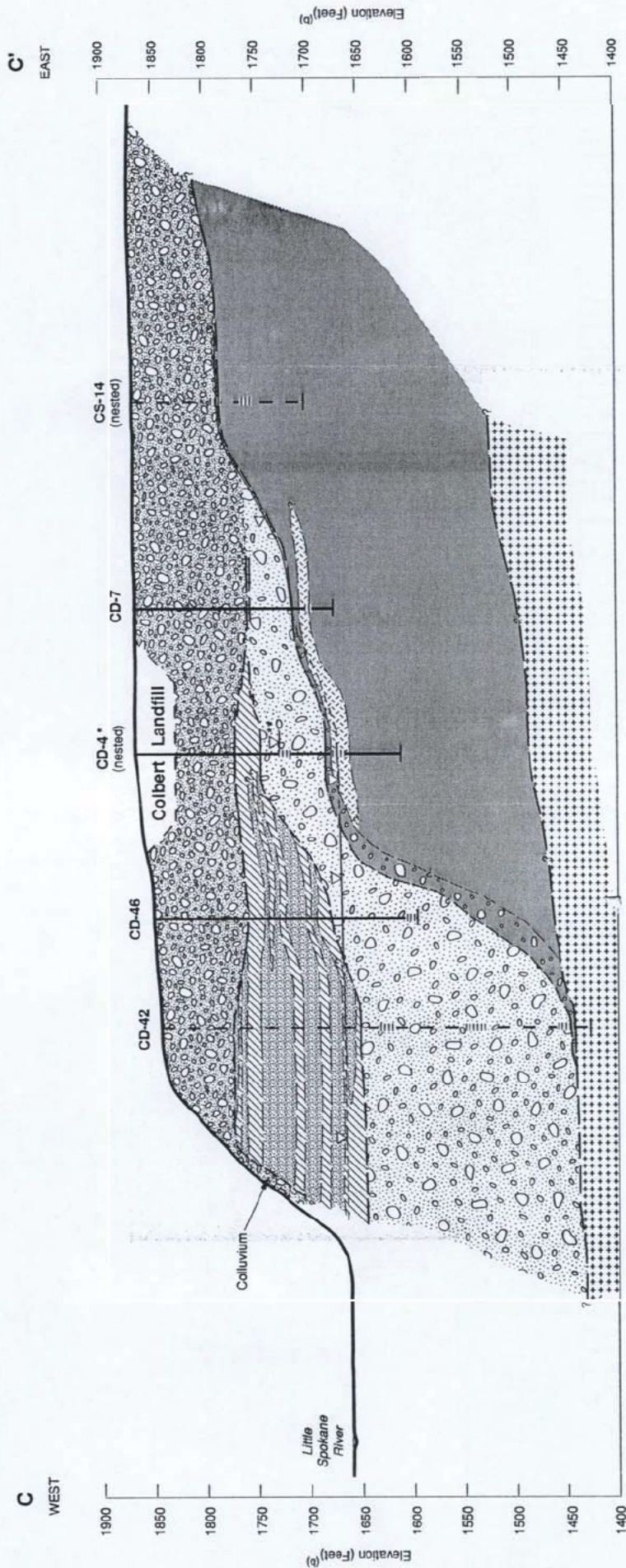
\* Plot Well included in cross section to show screen interval, geologic information is based on adjacent monitoring well boring data.

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Geologic Cross Section B-B'

Figure ER-4.4





Notes: a) Subsurface profiles shown have been generalized from data obtained during Phase I and other site investigations. Variations between this profile and the actual soil conditions may be encountered. The boring logs and the discussion in the text of this Report must be referenced for a proper understanding of the nature of subsurface materials.

b) All elevations in feet above mean sea level (MSL) based on 1929 National Geodetic Vertical Datum.

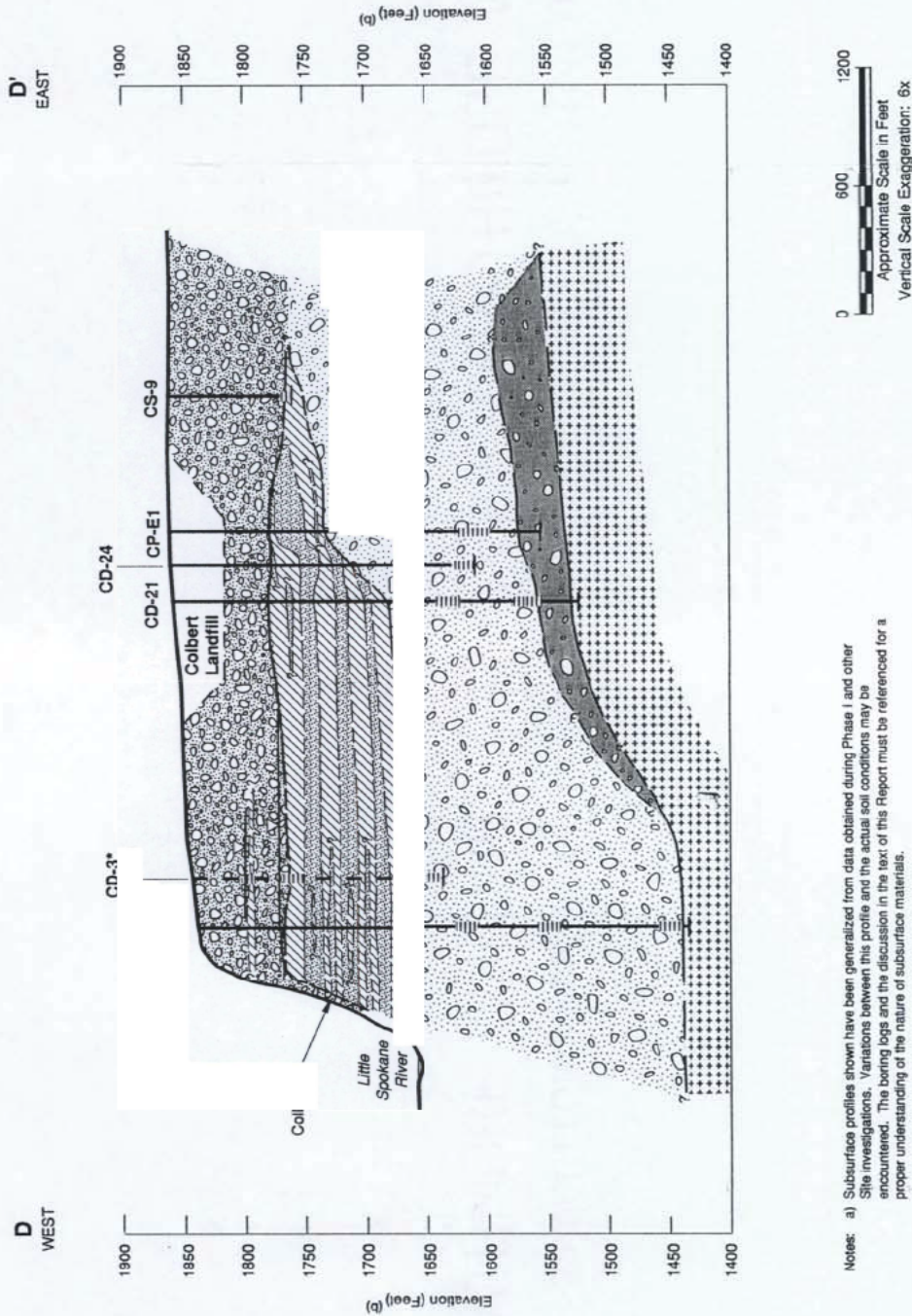
\* Well drilled by air rotary; detailed geology not identified in Lacustrine Aquifer Unit.

\*\* Ground water in CD-4(U) appears to be perched. However, an underlying aquifer is not identified on the boring log.

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Geologic Cross Section C-C'

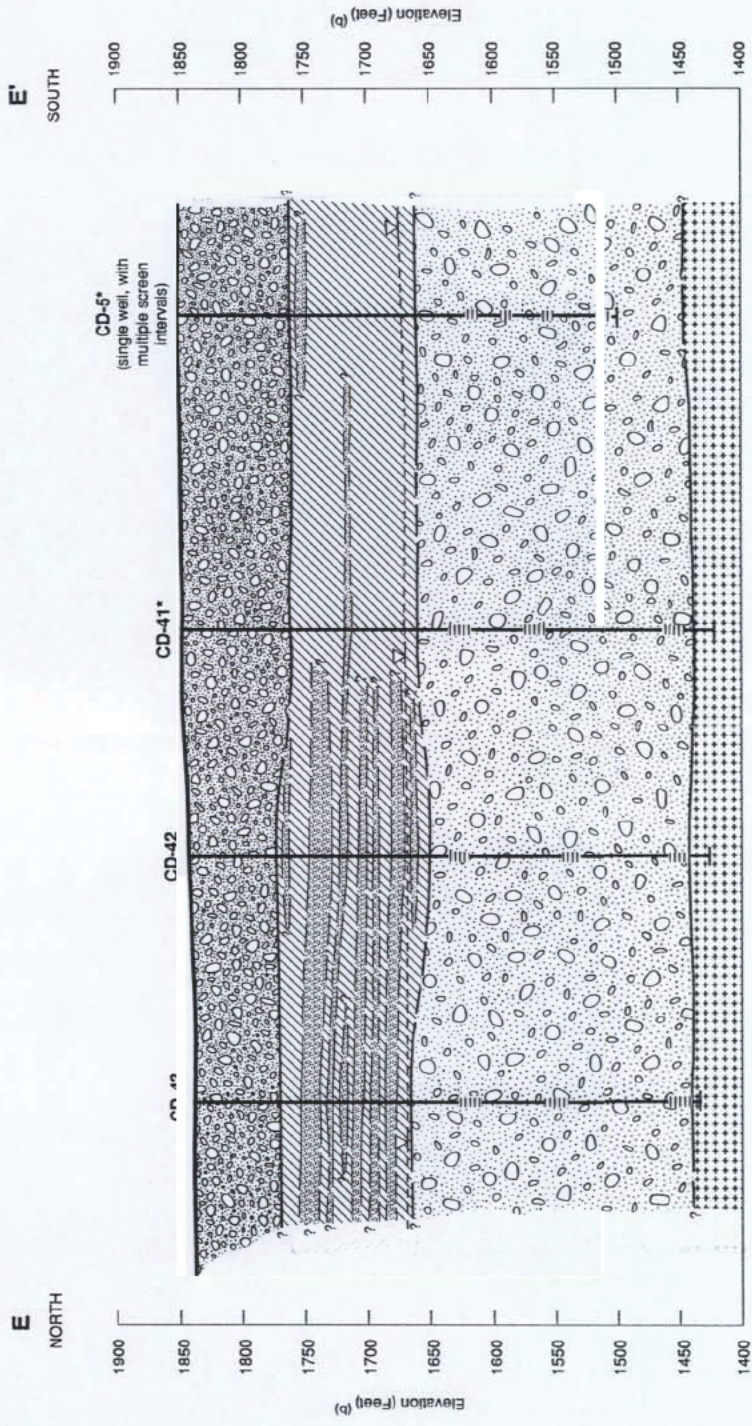




Notes: a) Subsurface profiles shown have been generalized from data obtained during Phase I and other Site investigations. Variations between this profile and the actual soil conditions may be encountered. The boring logs and the discussion in the text of this Report must be referenced for a proper understanding of the nature of subsurface materials.

b) All elevations in feet above mean sea level (MSL) based on 1929, National Geodetic Vertical Datum.

\* Well drilled by air rotary; detailed geology in Lacustrine Aquitard Unit based on CD-43 boring data.



Notes: a) Subsurface profiles shown have been generalized from data obtained during Phase I and other Site investigations. Variations between this profile and the actual soil conditions may be encountered. The boring logs and the discussion in the text of this Report must be referenced for a proper understanding of the nature of subsurface materials.

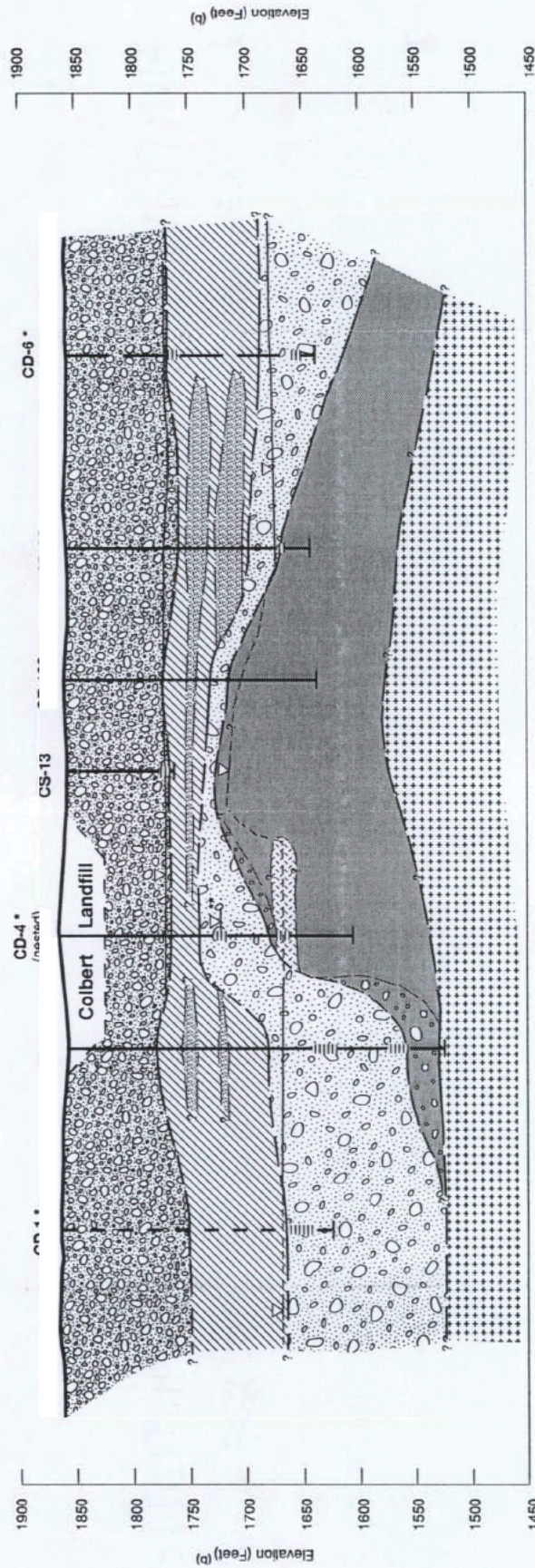
b) All elevations in feet above mean sea level (MSL) based on 1929, National Geodetic Vertical Datum.

\* Well drilled by air rotary, detailed geology not identified in Lacustrine Aquitard Unit.



F NORTH

F SOUTH



Notes: a) Subsurface profiles shown have been generalized from data obtained during Phase I and other Site investigations. Variations between this profile and the actual soil conditions may be encountered. The boring logs and the discussion in the text of this Report must be referenced for a proper understanding of the nature of subsurface materials.

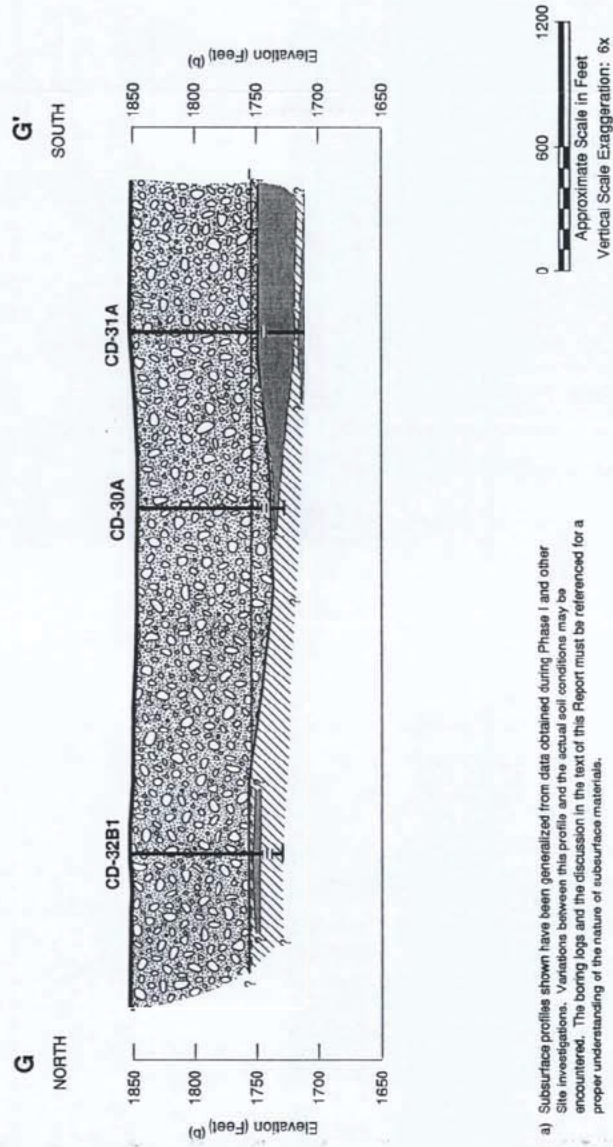
b) All elevations in feet above mean sea level (MSL) based on 1929, National Geodetic Vertical Datum.

\* Well drilled by air rotary; detailed geology not identified in Lacustrine Aquitard Unit.

\*\* Ground water in CD-4(U) appears to be perched. However, an underlying aquitard is not identified on the boring log.

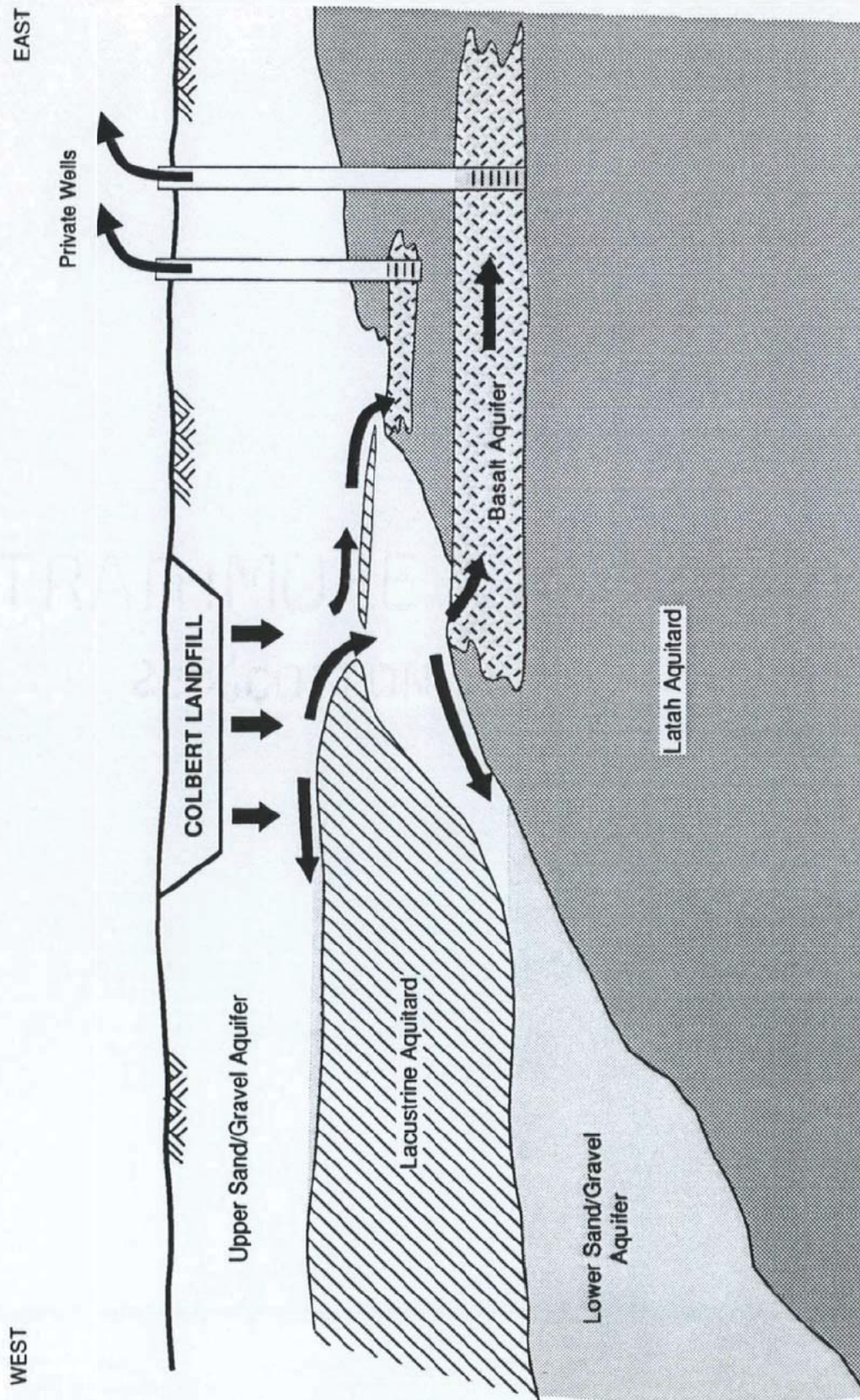
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Geologic Cross Section F-F



- Notes: a) Subsurface profiles shown have been generalized from data obtained during Phase I and other Site investigations. Variations between this profile and the actual soil conditions may be encountered. The boring logs and the discussion in the text of this Report must be referenced for a proper understanding of the nature of subsurface materials.
- b) All elevations in feet above mean sea level (MSL) based on 1929 National Geodetic Vertical Datum.





Not to Scale

KEY

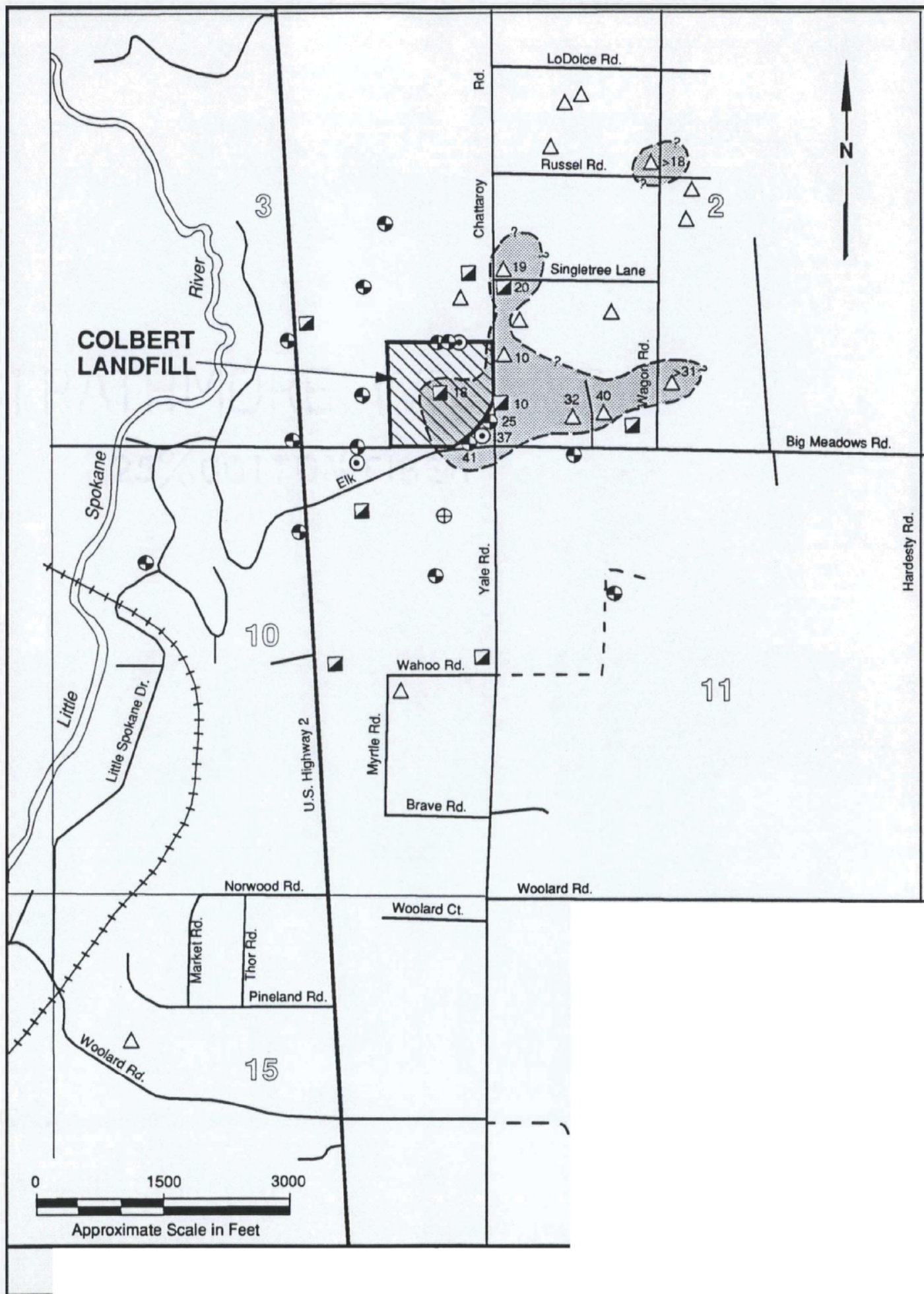
Ground Water Infiltration/Migration Direction

Extent of Saturation

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Conceptual Model - Ground Water Infiltration/Migration in the Colbert Landfill Vicinity

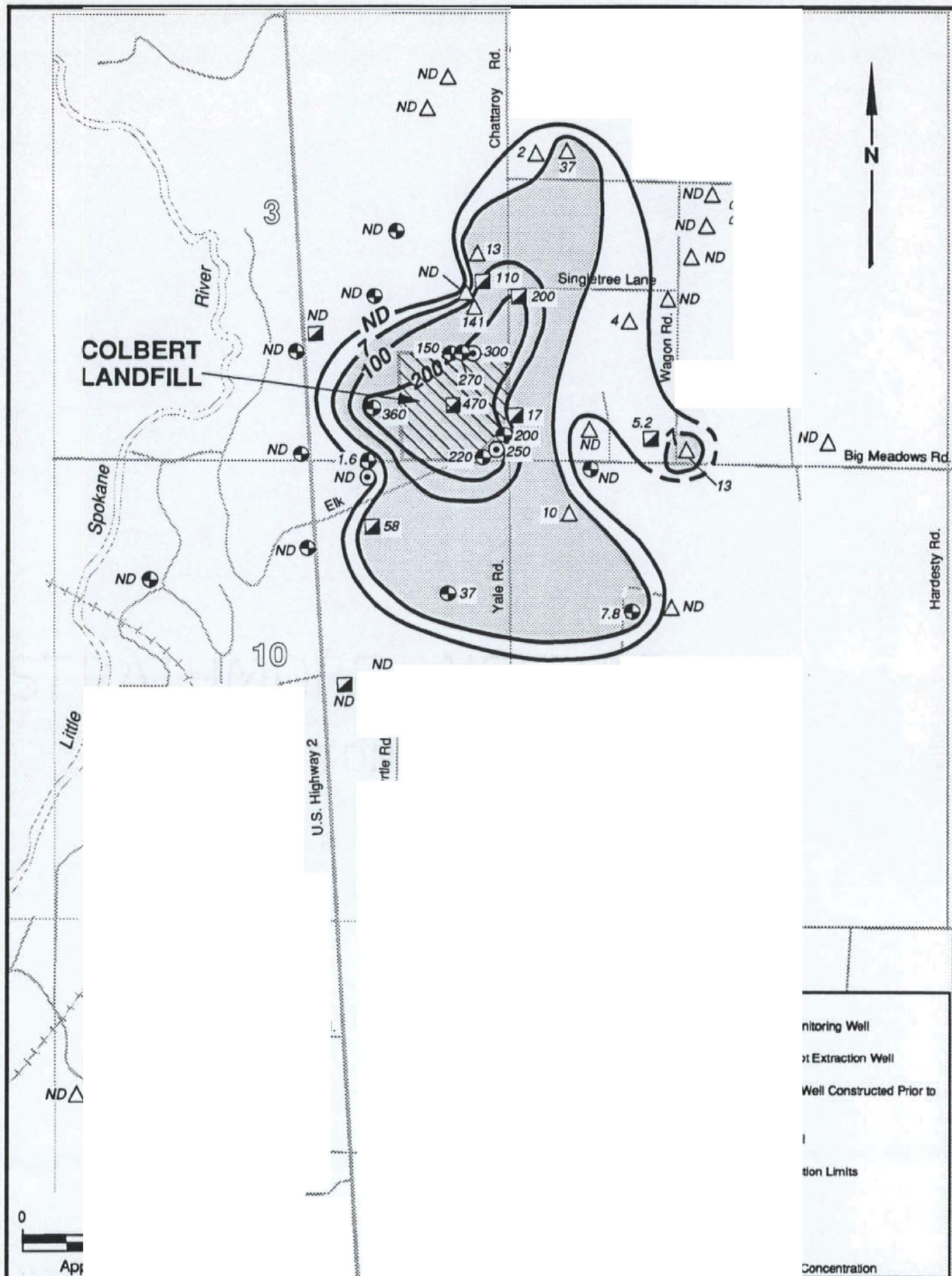








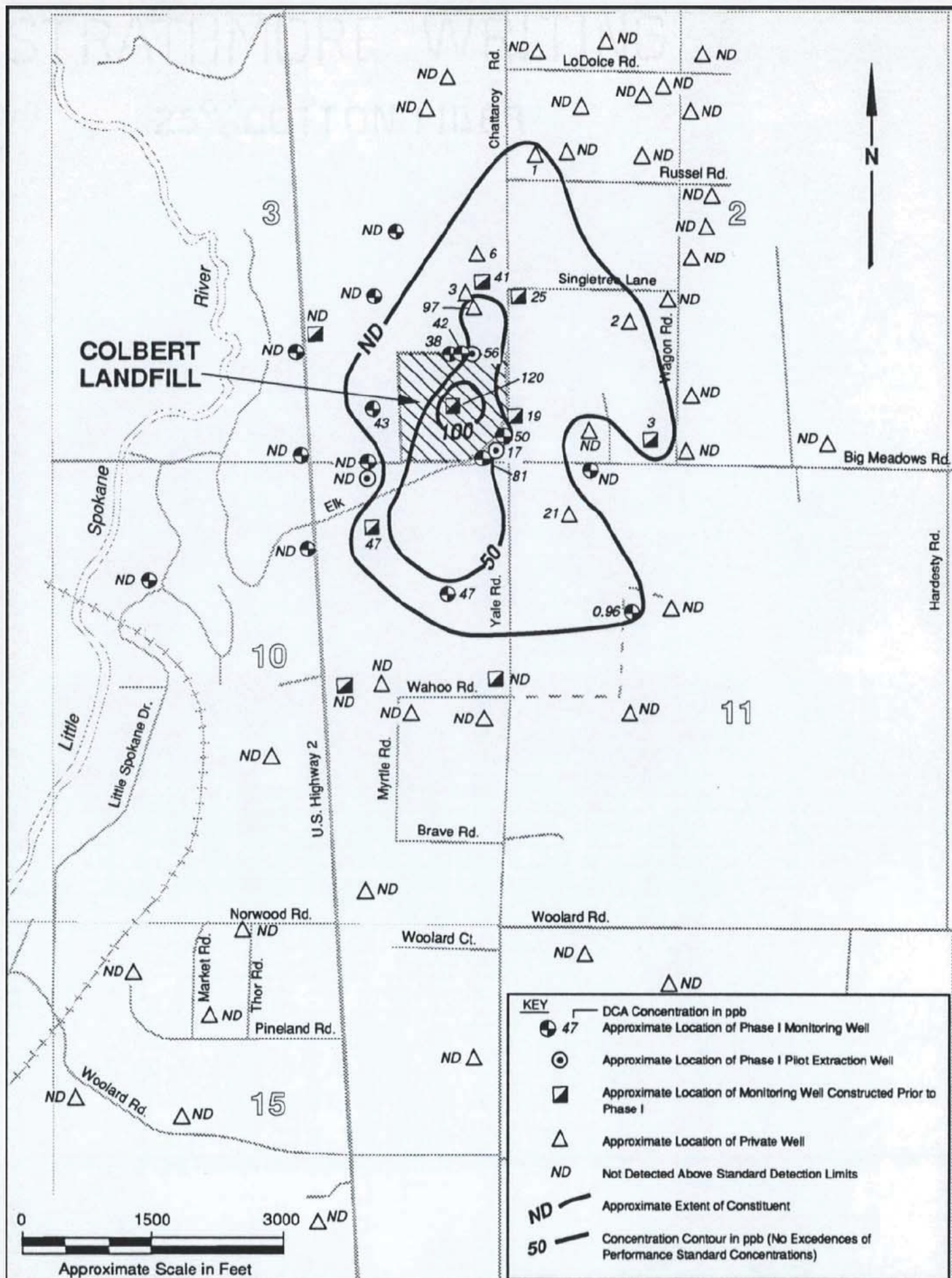




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Lower Aquifers  
DCE Distribution

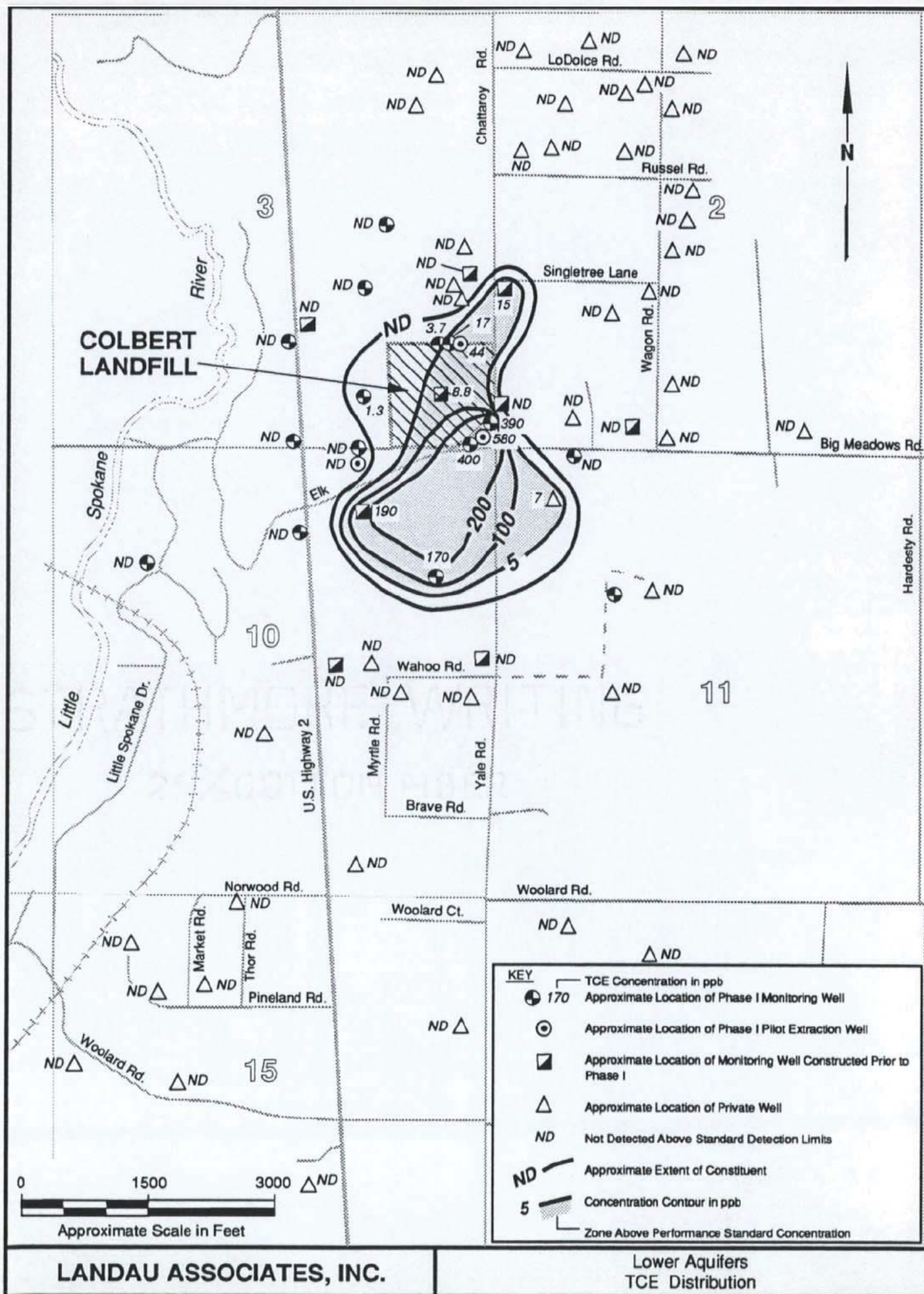




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Lower Aquifers  
DCA Distribution

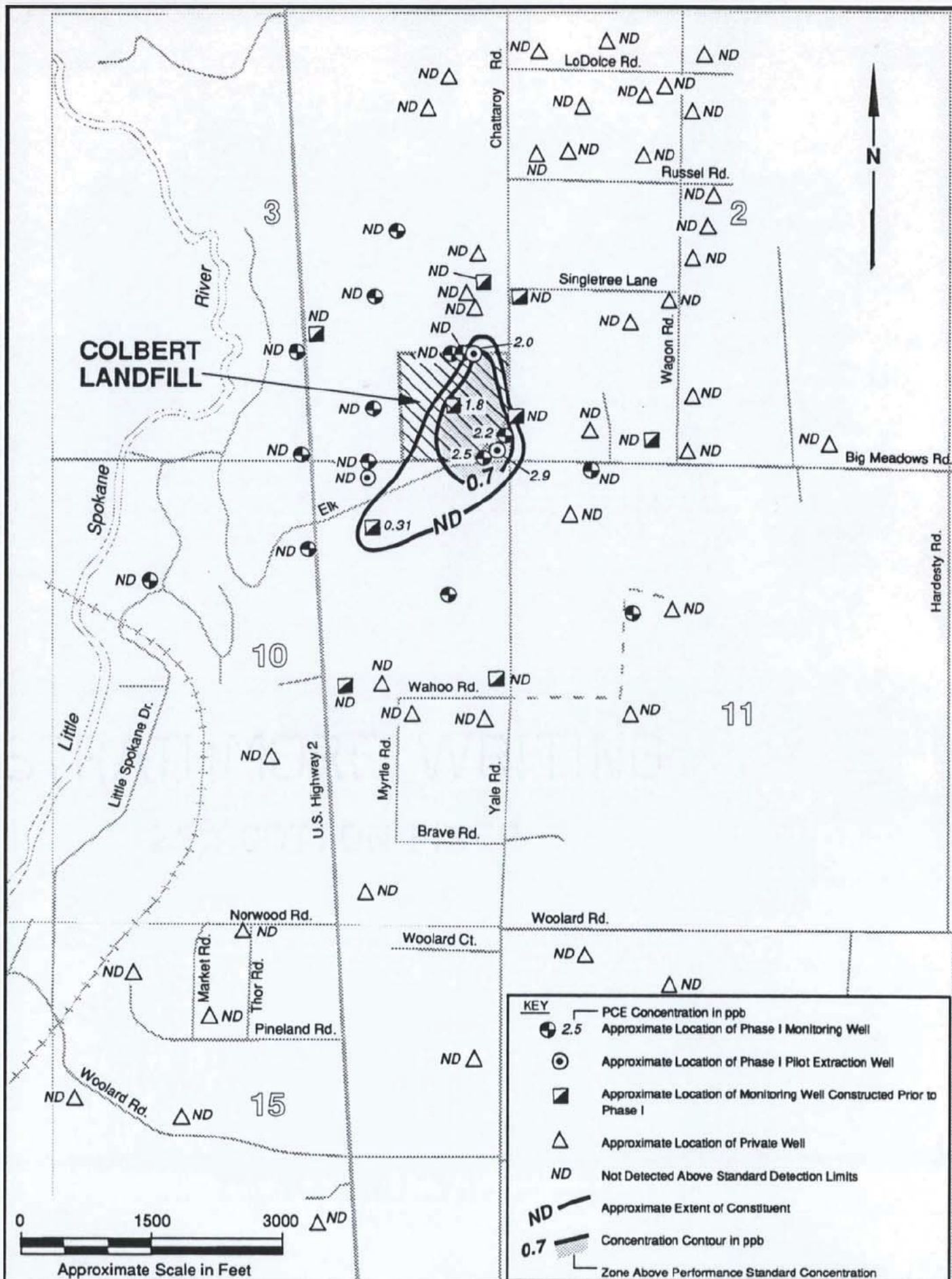












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Lower Aquifers  
PCE Distribution

Figure 2-3 Lower Aquifer Groundwater Contours

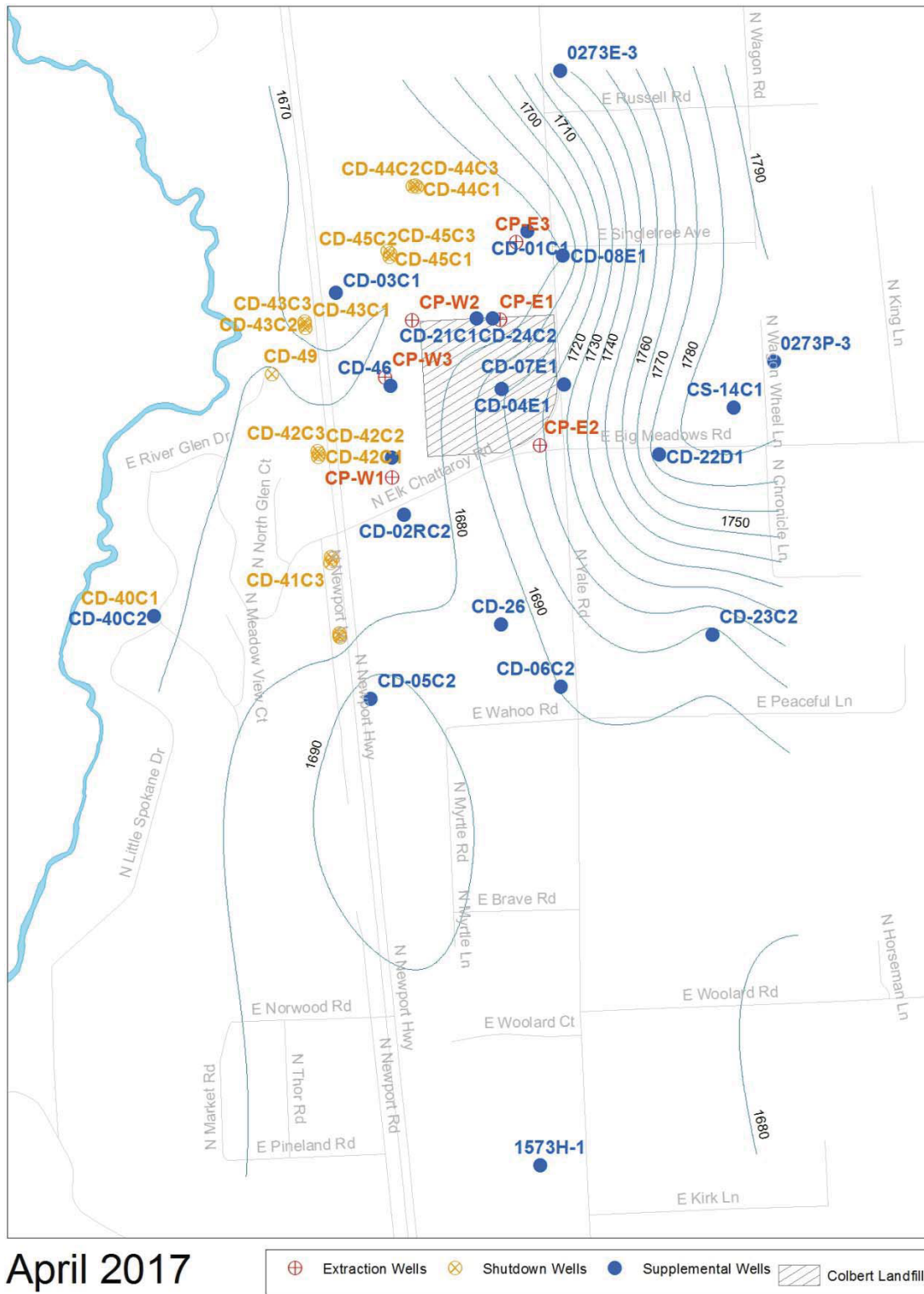


Figure 3-3 Upper Aquifer Estimated Groundwater Elevation Contours

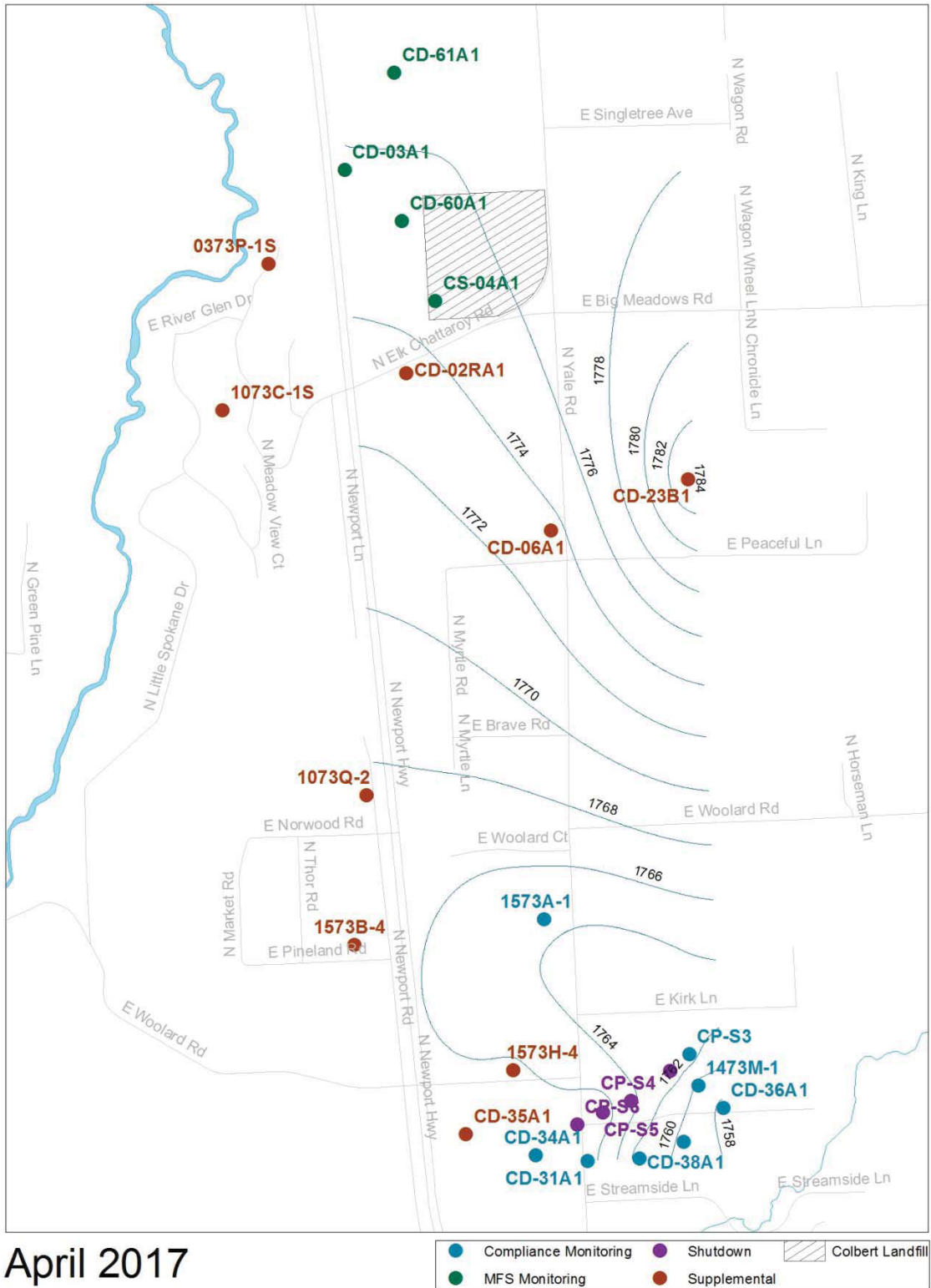
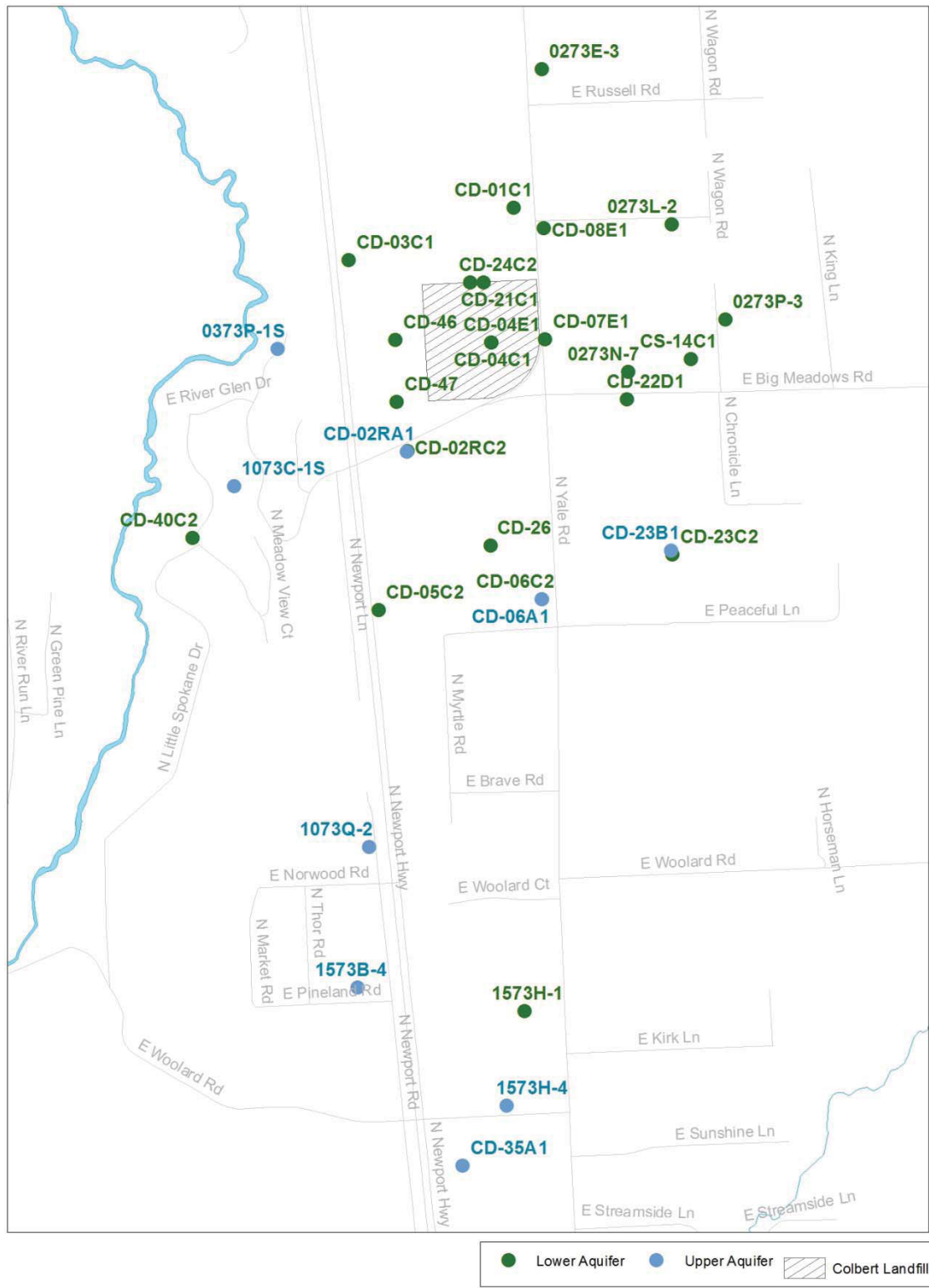
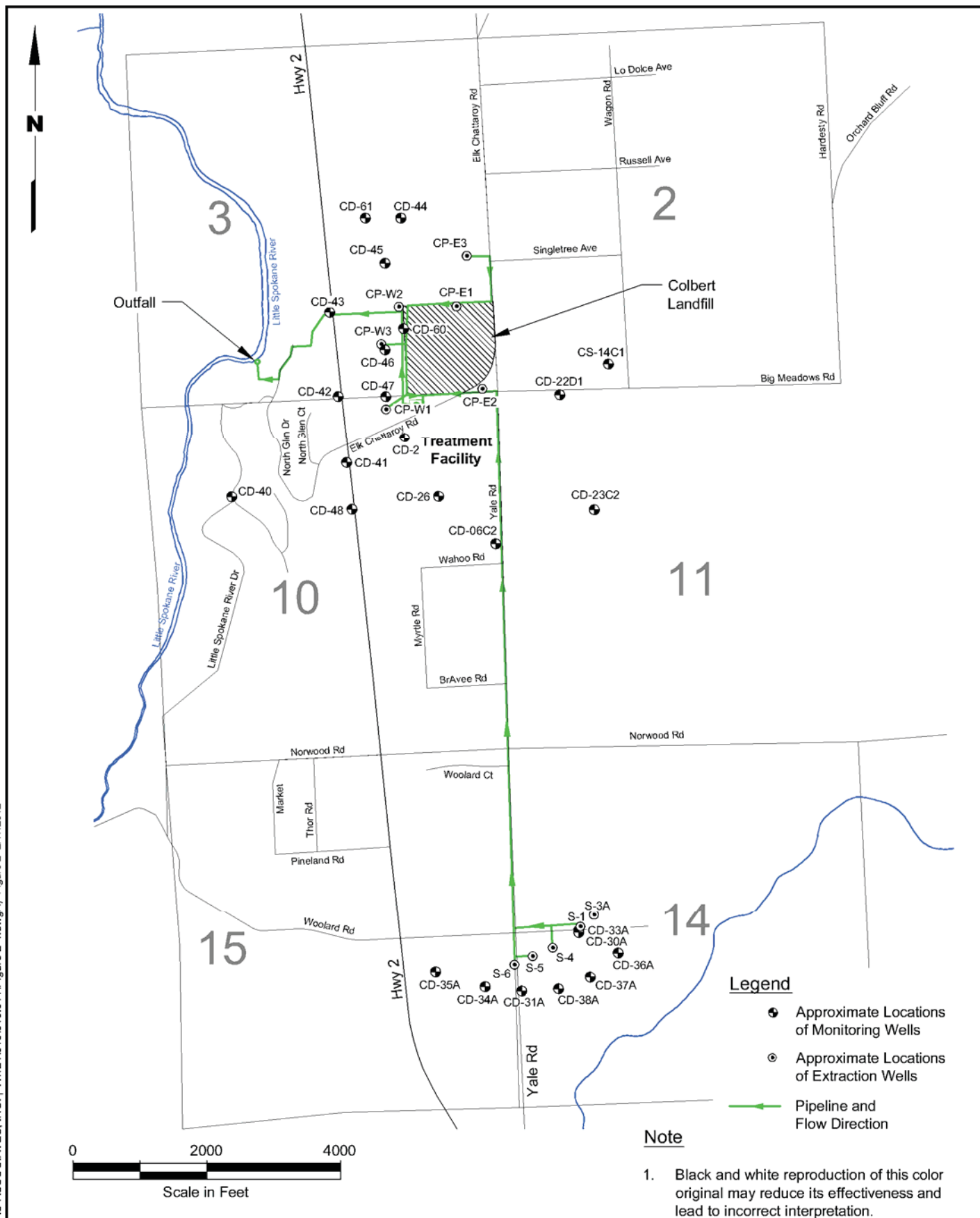


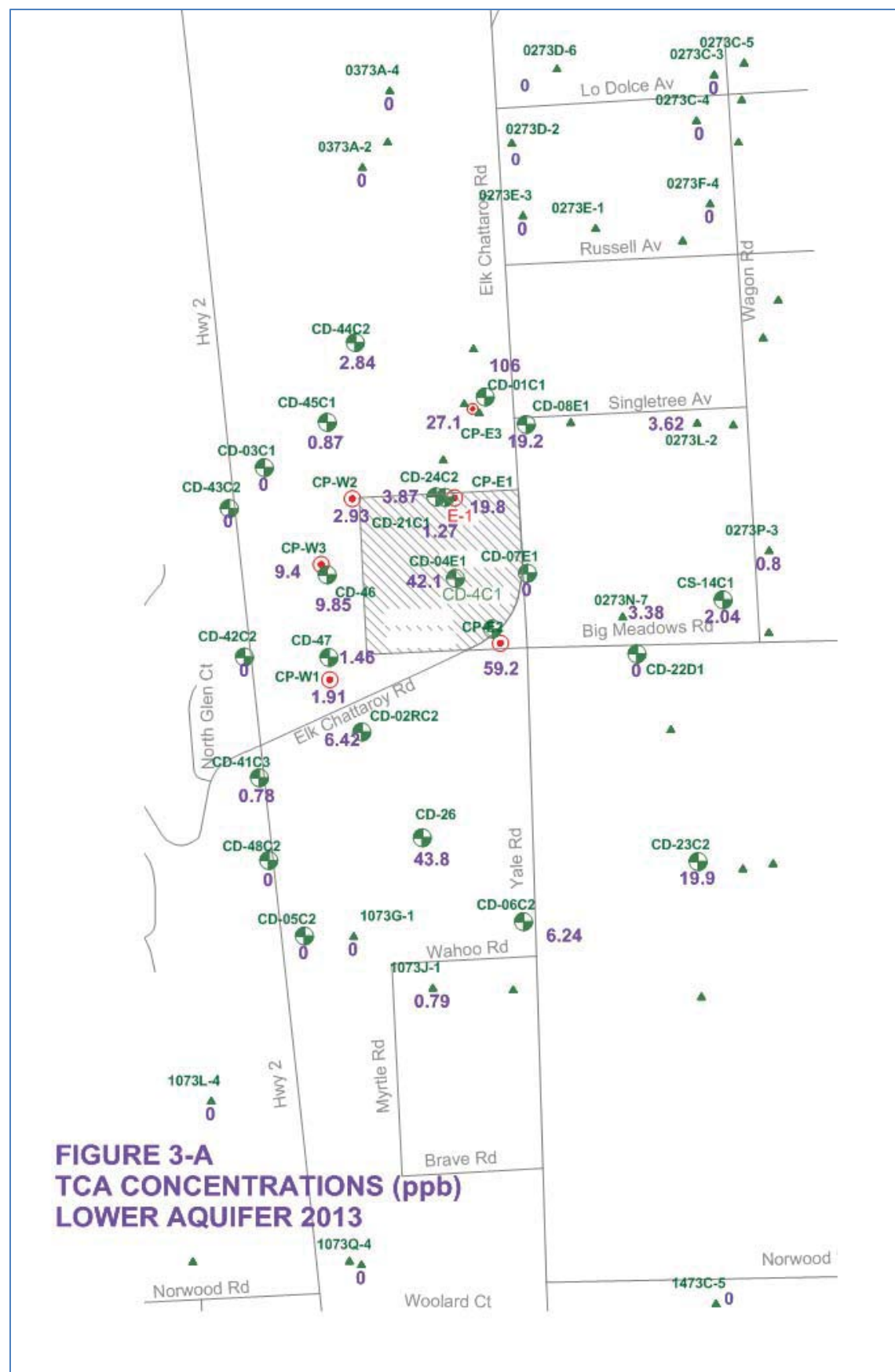


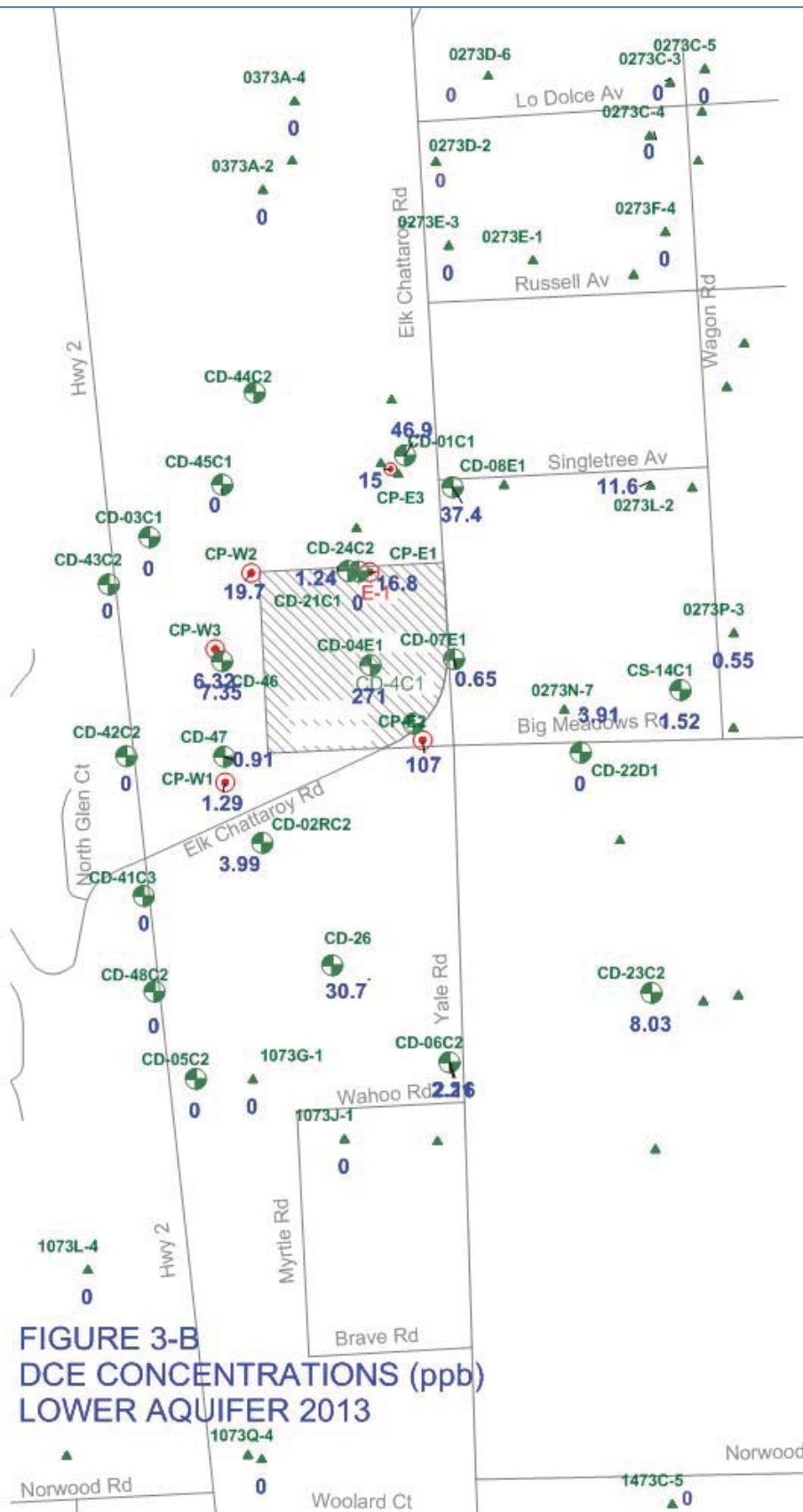
Figure 5-1 Supplemental Well Sampling Locations

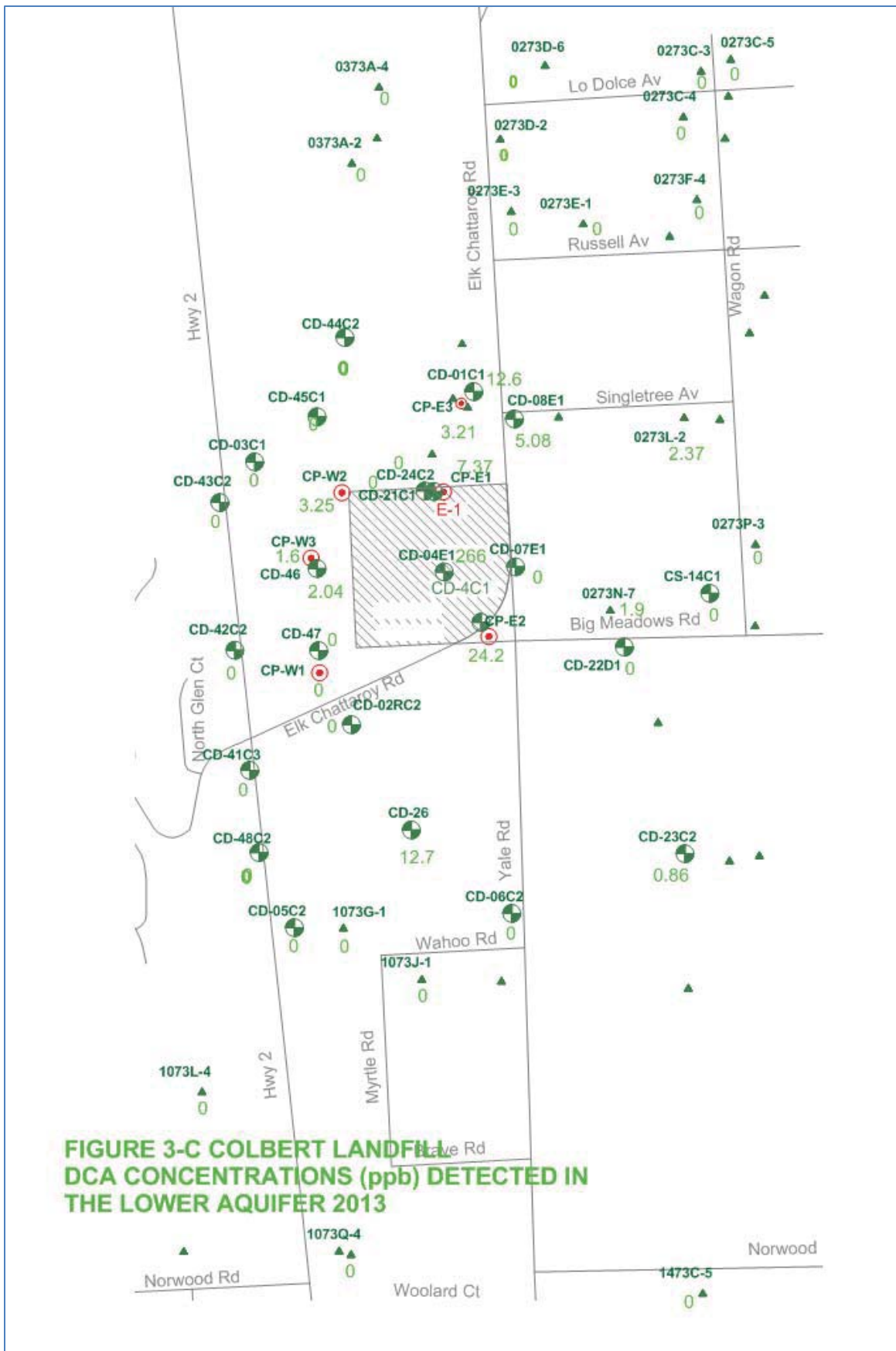


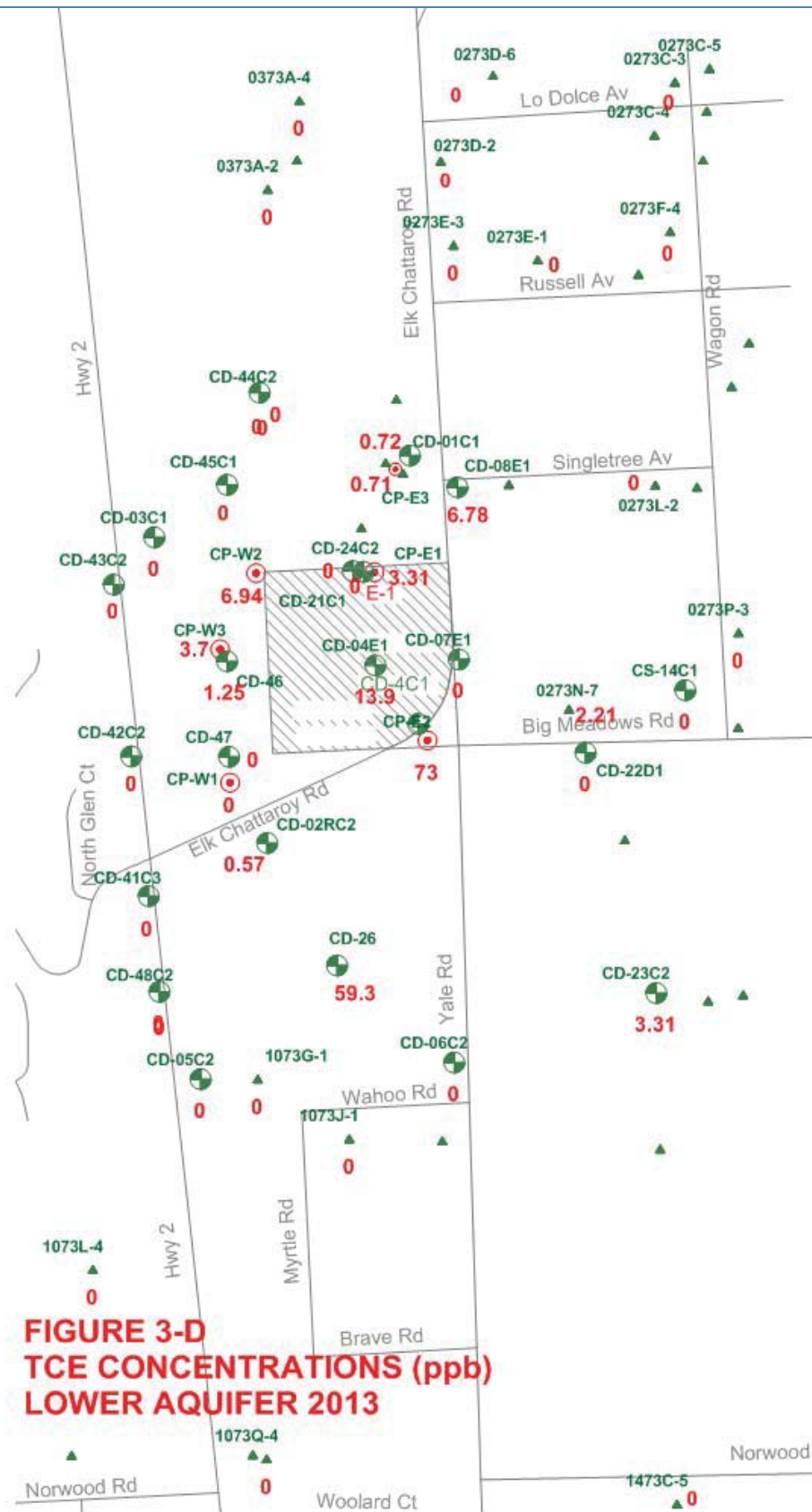




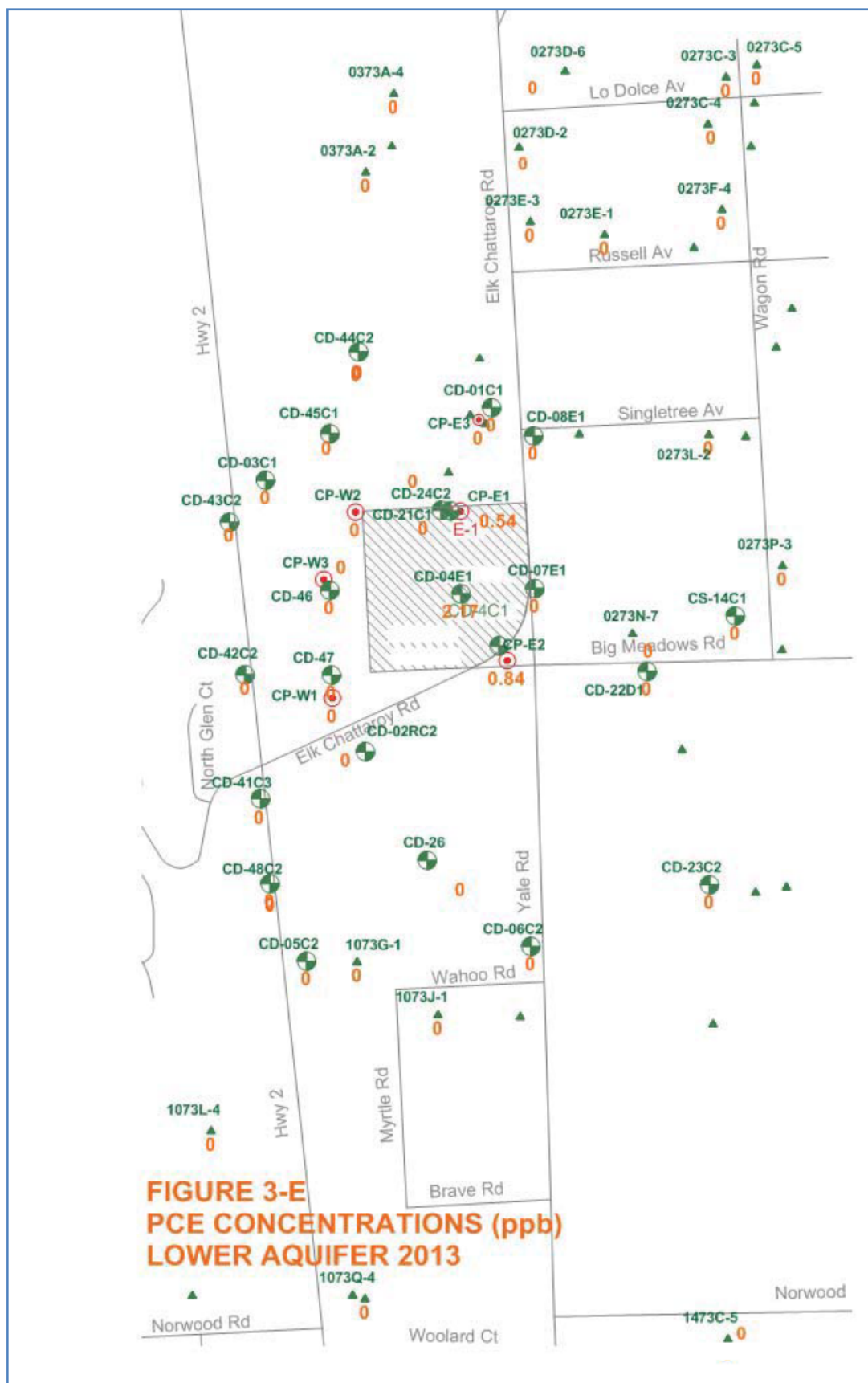


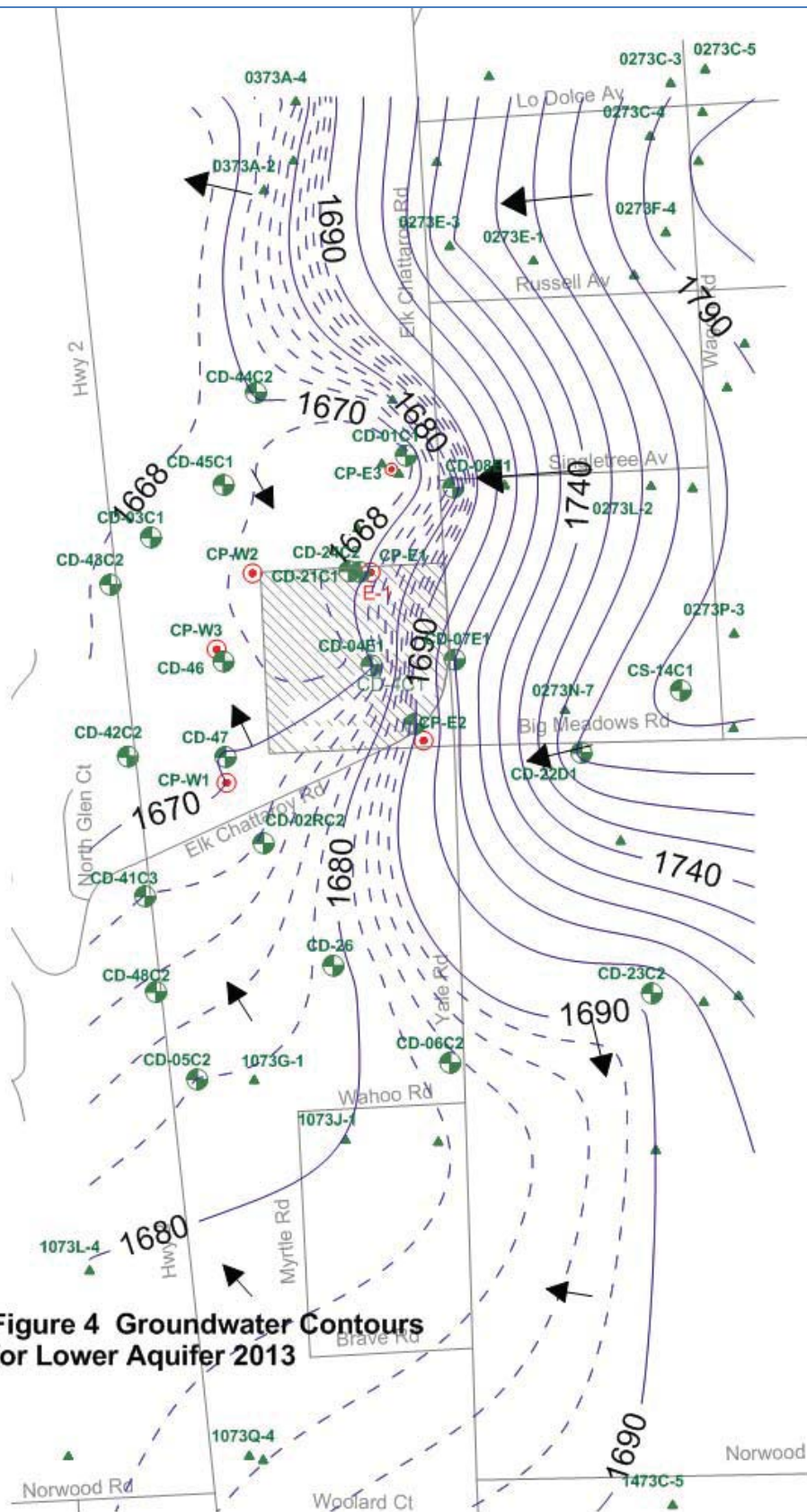












**Figure 4 Groundwater Contours  
for Lower Aquifer 2013**

Table 2-6 Analyte Detections for the Reporting Period

Location	DCA	DCE	PCE	TCA	TCE	dis-1,2-DCE	Cl	COD	Mn	N-NH3	N-NO3	SO4	TOC	Vc
0273L-2 (5/16/2012)	2.37	11.6		3.62										
0273N-7 (5/17/2012)	1.9	3.91		3.38	2.21									
0273P-3 (5/15/2012)		0.55		0.8										
1073K-1 (5/15/2012)	0.64	0.54		1.42	0.85									
1073Q-2 (5/16/2012)				1.11										
1473M-1 (5/22/2012)	0.74			0.67										
1573A-1 (5/15/2012)	3.2	1.11		4.52	1.54									
1573B-2 (5/14/2012)				0.85										
1573H-4 (5/15/2012)	0.51			1										
CD-01C1 (5/17/2012)	12.6	46.9		106	0.72									
CD-02RA1 (5/16/2012)			0.68		0.67									
CD-02RC2 (5/16/2012)		3.99		6.42	0.57									
CD-03A1 (5/23/2012)						0.88				0.527	6			
CD-04C1 (5/17/2012)	35.3	2.21			0.64									0.6
CD-04E1 (5/17/2012)	266	271	2.17	42.1	13.9	5.25								3.07
CD-06C2 (5/16/2012)		2.21		6.32										
CD-07E1 (5/14/2012)		0.65												
CD-08E1 (5/15/2012)	5.08	37.4		19.2	6.78									
CD-21C1 (5/16/2012)		1.24		3.87										
CD-23C2 (5/17/2012)	0.86	8.03		19.9	3.31									
CD-24C2 (5/15/2012)				1.27										
CD-26 (5/22/2012)	12.7	30.7		43.8	59.3	6.46								
CD-38A1 (5/21/2012)					0.59									
CD-40C1 (5/22/2012)	1.95	2.02		2.49										
CD-41C3 (5/21/2012)				0.78										
CD-44C1 (5/21/2012)		0.59		2.84										
CD-44C2 (5/21/2012)				0.55										
CD-44C3 (5/21/2012)				2.14										
CD-45C1 (5/21/2012)				0.87										
CD-46 (5/17/2012)	2.04	7.35		9.85	1.25									
CD-47 (5/15/2012)		0.91		1.46										
CD-60A1 (5/23/2012)			0.79		0.55	5.72			0.059	1.85	7.86	1.78		
CD-61A1 (5/23/2012)		1.23		4.86		0.7			0.036	0.199	7.86	1.47		
CP-E1 (5/23/2012)	7.91	16.8	0.53	21.8	3.58	0.91								
CP-E2 (5/23/2012)	30.6	107	0.74	88.2	94.6	22.2								
CP-E3 (5/23/2012)	2.71	15		28.4	1.09									
CP-S1 (5/23/2012)	3.74	0.92		1.77	2.29									
CP-S4 (5/23/2012)	1.57	0.7	0.69	1.53	2.36									
CP-S5 (5/23/2012)				0.71										
CP-S6 (5/23/2012)				0.8										
CP-W1 (5/23/2012)		1.29		1.96										
CP-W2 (5/23/2012)	3.89	19.7		30.7	6.73	0.9								
CP-W3 (5/23/2012)	1.39	6.32		9.7	3.78									
CS-04A1 (5/23/2012)		1.18		1.37		7.51	8.8	0.0175	0.062	5.26	10.6	4.23		
CS-14C1 (5/16/2012)		1.52		2.04										
EF24-02 (4/3/2012)						7.43		0.033						
IN20-11 (4/3/2012)	3.52	13.2		22.3	4.76	0.65								
IN20-11 (5/23/2012)	3.53	14.2		20.6	4.6	0.58								

\*Red highlight indicates concentration was above performance criteria.



**Table 1-4 Shut-down Test Location Analytical Results**

StationID	Date	DCA	DCE	MC	PCE	TCA	TCE
CD-41C1	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C1	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C1	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C1	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C2	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C2	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C2	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C2	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C3	Jul-14	<0.5	<0.5	<0.5	<0.5	0.68	<0.5
CD-41C3	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C3	Jan-15	<0.5	<0.5	<0.5	<0.5	0.58	<0.5
CD-41C3	Apr-15	<0.5	<0.5	<0.5	<0.5	0.59	<0.5
CD-42C1	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C1	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C1	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C1	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C2	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C2	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C2	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C2	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C3	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C3	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C3	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C3	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C1	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C1	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C1	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C1	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C2	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C2	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C2	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C2	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C3	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C3	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C3	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C3	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-44C1	Jul-14	<0.5	<0.5	<0.5	<0.5	2.35	<0.5
CD-44C1	Oct-14	<0.5	<0.5	<0.5	<0.5	3.01	<0.5
CD-44C1	Jan-15	<0.5	<0.5	<0.5	<0.5	2.6	<0.5
CD-44C1	Apr-15	<0.5	<0.5	<0.5	<0.5	3.13	<0.5
CD-44C2	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-44C2	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-44C2	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-44C2	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

**Table 1-4 Shut-down Test Location Analytical Results (Continued)**

StationID	Date	DCA	DCE	MC	PCE	TCA	TCE
CD-44C3	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-44C3	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-44C3	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-44C3	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C1	Jul-14	<0.5	<0.5	<0.5	<0.5	1.11	<0.5
CD-45C1	Oct-14	<0.5	<0.5	<0.5	<0.5	0.97	<0.5
CD-45C1	Jan-15	<0.5	<0.5	<0.5	<0.5	0.94	<0.5
CD-45C1	Apr-15	<0.5	<0.5	<0.5	<0.5	1	<0.5
CD-45C2	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C2	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C2	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C2	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C3	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C3	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C3	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C3	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C1	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C1	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C1	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C1	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C2	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C2	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C2	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C2	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C3	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C3	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C3	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C3	Apr-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-49	Jul-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-49	Oct-14	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-49	Jan-15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-49	Apr-15	<0.5	<0.5	<0.5	<0.5	0.72	<0.5

**Table 2-4 Shut-down Test Compliance Well Analytical Results**

StationID	Date	DCA	DCE	MC	PCE	TCA	TCE
CD-40C1	10-2015	1.67	1.19	<0.5	<0.5	2.07	<0.5
CD-40C1	4-2016	4.05	2.41	<0.5	<0.5	6.75	<0.5
CD-41C1	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C1	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C2	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C2	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C3	10-2015	<0.5	<0.5	<0.5	<0.5	0.58	<0.5
CD-41C3	4-2016	<0.5	<0.5	<0.5	<0.5	0.61	<0.5
CD-42C1	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C1	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C2	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C2	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C3	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C3	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C1	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C1	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C2	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C2	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C3	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C3	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-44C1	10-2015	<0.5	<0.5	<0.5	<0.5	3.3	<0.5
CD-44C1	4-2016	<0.5	<0.5	<0.5	<0.5	2.28	<0.5
CD-44C2	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-44C2	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-44C3	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-44C3	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C1	10-2015	<0.5	<0.5	<0.5	<0.5	1.11	<0.5
CD-45C1	4-2016	<0.5	<0.5	<0.5	<0.5	0.98	<0.5
CD-45C2	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C2	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C3	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C3	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C1	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C1	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C2	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C2	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C3	10-2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C3	4-2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-49	10-2015	<0.5	0.68	<0.5	<0.5	1.87	<0.5
CD-49	1-2016	<0.5	1.04	<0.5	<0.5	2.92	<0.5
CD-49	4-2016	<0.5	1.34	<0.5	<0.5	4.03	<0.5

**Table 2-4 Shut-down Test Compliance Well Analytical Results**

StationID	Date	DCA	DCE	MC	PCE	TCA	TCE
CD-40C1	4-2017	3.15	1.93	<0.5	<0.5	4.66	<0.5
CD-41C1	4-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C2	4-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-41C3	4-2017	<0.5	<0.5	<0.5	<0.5	0.84	<0.5
CD-42C1	4-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C2	4-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-42C3	4-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C1	4-2017	<0.5	<0.5	<0.5	<0.5	0.63	<0.5
CD-43C2	4-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-43C3	4-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-44C1	4-2017	<0.5	<0.5	<0.5	<0.5	2.05	<0.5
CD-44C2	4-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-44C3	4-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C1	4-2017	<0.5	<0.5	<0.5	<0.5	0.88	<0.5
CD-45C2	4-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-45C3	4-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C1	4-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C2	4-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-48C3	4-2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
CD-49	7-2016	<0.5	<0.5	<0.5	<0.5	5.33	<0.5
CD-49	10-2016	<0.5	1.79	<0.5	<0.5	5.36	<0.5
CD-49	1-2017	0.51	<0.5	<0.5	<0.5	7.81	<0.5
CD-49	4-2017	0.51	2.07	<0.5	<0.5	6.98	<0.5

**Table 1-5 Lower Aquifer Extraction Well Analytical Results**

StationID	Date	DCA	DCE	MC	PCE	TCA	TCE
CP-E1	Jul-14	5.75	11.2	<0.5	1.15	17.6	4.38
CP-E1	Oct-14	6.53	11.4	<0.5	1.42	13.5	5.39
CP-E1	Jan-15	7.09	12.8	<0.5	1.18	10.5	5.46
CP-E1	Apr-15	7.18	12.8	<0.5	1.18	9.87	5.89
CP-E2	Jul-14	28.2	85	<0.5	0.76	67.1	89.7
CP-E2	Oct-14	30.2	87.3	<0.5	0.83	66.8	81.5
CP-E2	Jan-15	26.5	73.8	<0.5	0.53	51.3	63.9
CP-E2	Apr-15	26.9	76.9	<0.5	0.56	52	75.2
CP-E3	Jul-14	3.79	18.2	<0.5	<0.5	27.6	1.32
CP-E3	Oct-14	3.68	18	<0.5	<0.5	23.5	1.35
CP-E3	Jan-15	3	15.7	<0.5	<0.5	16.4	0.98
CP-E3	Apr-15	2.85	16.4	<0.5	<0.5	16.8	0.97
CP-W1	Jul-14	<0.5	2.62	<0.5	<0.5	4.1	<0.5
CP-W1	Oct-14	<0.5	3.16	<0.5	<0.5	4.97	<0.5
CP-W1	Jan-15	<0.5	4.03	<0.5	<0.5	5.99	<0.5
CP-W1	Apr-15	<0.5	4.55	<0.5	<0.5	6.61	<0.5
CP-W2	Jul-14	<0.5	<0.5	<0.5	<0.5	0.88	<0.5
CP-W2	Oct-14	<0.5	<0.5	<0.5	<0.5	1.16	<0.5
CP-W2	Jan-15	<0.5	<0.5	<0.5	<0.5	0.85	<0.5
CP-W2	Apr-15	<0.5	0.63	<0.5	<0.5	1.64	<0.5
CP-W3	Jul-14	3.85	6.53	<0.5	<0.5	20.3	5.66
CP-W3	Oct-14	6.29	14	<0.5	<0.5	26.6	9.88
CP-W3	Jan-15	6.74	20.1	<0.5	<0.5	38.8	11.6
CP-W3	Apr-15	9.32	27.6	<0.5	<0.5	48	14.8

**Table 2-5 Lower Aquifer Extraction Well Analytical Results**

StationID	Date	DCA	DCE	MC	PCE	TCA	TCE
CP-E1	10-2015	8.03	10.8	<0.5	1.75	8.12	6.17
CP-E1	1-2016	9.31	13.6	<0.5	1.99	9.3	7.32
CP-E1	4-2016	7.55	11.9	<0.5	1.84	7	6.41
CP-E2	10-2015	27.2	100	<0.5	0.82	61.9	83.5
CP-E2	1-2016	33.1	109	<0.5	0.83	72.3	101
CP-E2	4-2016	27.5	95.4	<0.5	0.9	56	91.7
CP-E3	10-2015	3.19	15.6	<0.5	<0.5	16.5	1.28
CP-E3	1-2016	3.39	18.1	<0.5	<0.5	17.7	1.37
CP-E3	4-2016	2.89	17.4	<0.5	<0.5	15.6	1.63
CP-W1	10-2015	0.52	4.86	<0.5	<0.5	7.65	<0.5
CP-W1	1-2016	0.57	6.11	<0.5	<0.5	8.77	<0.5
CP-W1	4-2016	<0.5	5.65	<0.5	<0.5	6.88	<0.5
CP-W2	10-2015	<0.5	<0.5	<0.5	<0.5	1.26	<0.5
CP-W2	1-2016	<0.5	<0.5	<0.5	<0.5	1.75	<0.5
CP-W2	4-2016	<0.5	<0.5	<0.5	<0.5	1.29	<0.5
CP-W3	10-2015	20.7	36.6	<0.5	<0.5	70.3	32.2
CP-W3	1-2016	27.7	49.2	<0.5	<0.5	85.8	31.5
CP-W3	4-2016	28.5	56.6	<0.5	<0.5	92.1	29.9



**Table 2-5 Lower Aquifer Extraction Well Analytical Results**

StationID	Date	DCA	DCE	MC	PCE	TCA	TCE
CP-E1	7-2016	8.23	12	<0.5	1.99	7.53	7.17
CP-E1	10-2016	8.31	11.4	<0.5	1.83	6.55	6.85
CP-E1	1-2017	8.52	14.80	<0.5	1.87	7.13	7.23
CP-E1	4-2017	10.3	16	<0.5	2	9.26	7.74
CP-E2	7-2016	30	95.8	<0.5	0.8	54.8	88.7
CP-E2	10-2016	28.6	107	<0.5	0.82	45.6	117
CP-E2	1-2017	32.80	123.00	<0.5	0.86	52.00	131.00
CP-E2	4-2017	29.9	103	<0.5	0.76	62.7	92.9
CP-E3	7-2016	3.3	16.9	<0.5	<0.5	14.6	2.26
CP-E3	10-2016	2.85	13.5	<0.5	<0.5	11.8	1.37
CP-E3	1-2017	2.95	16.80	<0.5	<0.5	11.70	1.97
CP-E3	4-2017	3.96	16.3	<0.5	<0.5	14.4	2.34
CP-W1	7-2016	<0.5	5.5	<0.5	<0.5	6.8	<0.5
CP-W1	10-2016	<0.5	4.45	<0.5	<0.5	5.67	<0.5
CP-W1	1-2017	<0.5	5.45	<0.5	<0.5	5.70	<0.5
CP-W1	4-2017	<0.5	5.06	<0.5	<0.5	6.26	<0.5
CP-W2	7-2016	<0.5	<0.5	<0.5	<0.5	1.47	<0.5
CP-W2	10-2016	<0.5	0.56	<0.5	<0.5	1.69	<0.5
CP-W2	1-2017	<0.5	0.85	<0.5	<0.5	2.22	<0.5
CP-W2	4-2017	<0.5	<0.5	<0.5	<0.5	2.06	<0.5
CP-W3	7-2016	34.9	70.1	<0.5	<0.5	94.4	33.5
CP-W3	10-2016	38.8	76.8	<0.5	<0.5	96.3	33.7
CP-W3	1-2017	42.70	90.00	<0.5	<0.5	105.00	36.60
CP-W3	4-2017	37.1	66.8	<0.5	<0.5	88.5	40.2

**Table 3-4 Upper Aquifer Groundwater Monitoring Results**

StationID	SampleDate	DCA	DCE	MC	PCE	TCA	TCE	Cl	COD	Fe	Mn	N-NH3	N-NO3	SO4	TOC	Zn
1573A-1	4/19/2017	1.87	0.78	<0.5	<0.5	1.77	0.95									
CD-03A1	4/20/2017	<0.5	<0.5	<0.5	<0.5	0.58	<0.5	0.68	<5	<0.1	<0.008	<0.03	0.143	5.3	<1	<0.01
CD-31A1	4/18/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CD-34A1	4/18/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CD-36A1	4/18/2017	1.76	<0.5	<0.5	<0.5	0.7	1.07									
CD-37A1	4/18/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CD-38A1	4/18/2017	<0.5	<0.5	<0.5	<0.5	0.84	<0.5									
CD-60A1	4/20/2017	<0.5	<0.5	<0.5	1.12	<0.5	<0.5	2.85	<5	<0.1	<0.008	<0.03	1.37	6.45	<1	<0.01
CD-61A1	4/20/2017	<0.5	<0.5	<0.5	<0.5	2.41	<0.5	0.66	<5	<0.1	<0.008	<0.03	0.093	10.6	<1	<0.01
CP-S1	7/12/2016	2.11	0.7	<0.5	<0.5	1.26	1.53									
CP-S1	1/18/2017	1.74	0.64	<0.5	<0.5	0.98	1.38									
CP-S1	4/19/2017	3.3	0.73	<0.5	<0.5	1.13	2.04									
CP-S3	4/19/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S4	7/12/2016	1.15	<0.5	<0.5	0.75	0.78	2.33									
CP-S4	10/5/2016	1.08	<0.5	<0.5	0.56	0.7	1.85									
CP-S4	1/18/2017	1.5	0.56	<0.5	0.58	0.84	2.25									
CP-S4	4/19/2017	<0.5	0.53	<0.5	0.65	0.53	1.81									
CP-S5	7/12/2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S5	10/5/2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S5	1/18/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S5	4/19/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S6	7/12/2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S6	10/5/2016	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S6	1/18/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CP-S6	4/20/2017	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5									
CS-04A1	4/20/2017	0.61	<0.5	<0.5	<0.5	<0.5	0.53	<0.2	<5	<0.1	0.0133	<0.03	0.067	2.52	1.16	<0.01

**Colbert Landfill**  
**Summary of All Supplemental Sampling**  
**Constituent of Concern Concentrations**  
**from 1995 to 2012 (ppb)**

StationID	SampleID	SampleDate	DCA	DCE	MC	PCE	TCA	TCE	Aquifer
CD-24C2	CD-24C2-950322	3/22/1995	4.1	33	<0.5	<0.5	240	0.8	lower
CD-24C2	CD-24C2-010523	5/23/2001	<0.5	2.41	<0.5	<0.5	11.62	<0.5	lower
CD-24C2	CD-24C2-070508	5/8/2007	<0.5	0.72	<0.5	<0.5	0.93	<0.5	lower
CD-24C2	CD-24C2-120515	5/15/2012	<0.5	<0.5	<0.5	<0.5	1.27	<0.5	lower
CD-26	CD-26-010524	5/24/2001	29.1	29.9	<0.5	<0.5	129.4	117.9	lower
CD-26	CD-26-070510	5/10/2007	20.3	32.4	<0.5	<0.5	81.4	79	lower
CD-26	HSCD-26-070510	5/10/2007	9.13	17.7	<0.5	<0.5	56.9	54.6	lower
CD-26	CD-26-120522	5/22/2012	12.7	30.7	<0.5	<0.5	43.8	59.3	lower
CD-32B1	CD-32B1-950329	3/29/1995	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
CD-32B1	CD-32B1-010522	5/22/2001	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
CD-32B1	CD-32B1-070507	5/7/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
CD-32B1	CD-32B1-120514	5/14/2012	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
CD-35A1	CD-35A1-950328	3/28/1995	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
CD-35A1	CD-35A1-010522	5/22/2001	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
CD-35A1	CD-35A1-070507	5/7/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
CD-35A1	CD-35A1-120514	5/14/2012	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
CD-40C2	CD-40C2-950428	4/28/1995	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CD-40C2	CD-40C2-070508	5/8/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CD-40C2	CD-40C2-120515	5/15/2012	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CD-46	CD-46-070508	5/8/2007	3.49	9.17	<0.5	<0.5	27.8	2.15	lower
CD-46	CD-46-120517	5/17/2012	2.04	7.35	<0.5	<0.5	9.85	1.25	lower
CD-47	CD-47C2-010524	5/24/2001	<0.5	2.32	<0.5	<0.5	13.75	<0.5	lower
CD-47	CD-47-070510	5/10/2007	<0.5	1.82	<0.5	<0.5	3.67	<0.5	lower
CD-47	CD-55-070510	5/10/2007	<0.5	1.75	<0.5	<0.5	3.61	<0.5	lower
CD-47	CD-47-120515	5/15/2012	<0.5	0.91	<0.5	<0.5	1.46	<0.5	lower
CS-14C1	CS-14C1-950322	3/22/1995	2.3	7.2	<0.5	<0.5	63	<0.5	lower
CS-14C1	CS-14C1-010523	5/23/2001	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CS-14C1	CS-14C1-070508	5/8/2007	<0.5	2.7	<0.5	<0.5	5.14	<0.5	lower
CS-14C1	CS-14C1-120516	5/16/2012	<0.5	1.52	<0.5	<0.5	2.04	<0.5	lower



**Colbert Landfill**  
**Summary of All Supplemental Sampling**  
**Constituent of Concern Concentrations**  
**from 1995 to 2012 (ppb)**

StationID	SampleID	SampleDate	DCA	DCE	MC	PCE	TCA	TCE	Aquifer
CD-04E1	CD-04E1-950323	3/23/1995	260	360	420	7.9	1600	36	lower
CD-04E1	CD-04E1-010524	5/24/2001	340	300.6	0.64	3	188.2	20.33	lower
CD-04E1	CD-04E1-070511	5/11/2007	359	288	0.75	3.3	108	18.9	lower
CD-04E1	CD-04E1-120517	5/17/2012	266	271	<0.5	2.17	42.1	13.9	lower
CD-05C2	CD-05C2-950323	3/23/1995	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CD-05C2	CD-05C2-010524	5/24/2001	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CD-05C2	CD-05C2-070507	5/7/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CD-05C2	CD-05C2-120514	5/14/2012	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CD-06A1	CD-06A1-950329	3/29/1995	8.9	4.8	<0.5	<0.5	52	1.9	upper
CD-06A1	FD-CD06A1-950329	3/29/1995	7.8	4.1	<0.5	<0.5	46	1.7	upper
CD-06A1	CD-06A1-960710	7/10/1996	5.5	<0.5	<0.5	<0.5	24	1.5	upper
CD-06A1	CD-06A1-010523	5/23/2001	1.94	4.54	<0.5	<0.5	22.5	<0.5	upper
CD-06A1	CD-52-010523	5/23/2001	1.9	4.76	<0.5	<0.5	21.9	<0.5	upper
CD-06A1	CD-06A1-070509	5/9/2007	<0.5	0.51	<0.5	<0.5	1.64	<0.5	upper
CD-06A1	CD-06A1-120516	5/16/2012	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
CD-06C2	CD-06C2-950323	3/23/1995	<0.5	1.3	<0.5	<0.5	33	<0.5	lower
CD-06C2	CD-06C2-010523	5/23/2001	<0.5	0.5	<0.5	<0.5	4.82	<0.5	lower
CD-06C2	CD-06C2-070509	5/9/2007	<0.5	1.5	<0.5	<0.5	4.45	<0.5	lower
CD-06C2	CD-06C2-120516	5/16/2012	<0.5	2.16	<0.5	<0.5	6.24	<0.5	lower
CD-06C2	CD-51-120516	5/16/2012	<0.5	2.21	<0.5	<0.5	6.32	<0.5	lower
CD-07E1	CD-07E1-070509	5/9/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CD-07E1	CD-07E1-120514	5/14/2012	<0.5	0.65	<0.5	<0.5	<0.5	<0.5	lower
CD-08E1	CD-08E1-010523	5/23/2001	10.43	54.3	<0.5	<0.5	66.3	9.37	lower
CD-08E1	CD-08E1-070510	5/10/2007	7.27	54.5	<0.5	<0.5	40.9	8.82	lower
CD-08E1	CD-08E1-120515	5/15/2012	5.08	37.4	<0.5	<0.5	19.2	6.78	lower
CD-21C1	CD-21C1-950322	3/22/1995	6.1	47	<0.5	<0.5	390	1.1	lower
CD-21C1	CD-21C1-010523	5/23/2001	<0.5	2.34	<0.5	<0.5	16.97	<0.5	lower
CD-21C1	CD-50-010523	5/23/2001	<0.5	2.62	<0.5	<0.5	18.52	<0.5	lower
CD-21C1	CD-21C1-070510	5/10/2007	<0.5	0.85	<0.5	<0.5	1.11	<0.5	lower
CD-21C1	CD-21C1-120516	5/16/2012	<0.5	1.24	<0.5	<0.5	3.87	<0.5	lower
CD-22D1	CD-22D1-010523	5/23/2001	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CD-22D1	CD-22D1-070507	5/7/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CD-22D1	CD-22D1-120514	5/14/2012	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CD-23B1	CD-23A1-950329	3/29/1995	1.3	5.6	<0.5	<0.5	88	<0.5	upper
CD-23B1	CD-23B1-010522	5/22/2001	<0.5	0.65	<0.5	<0.5	4.24	<0.5	upper
CD-23B1	CD-23B1P-010522	5/22/2001	<0.5	0.86	<0.5	<0.5	6.53	<0.5	upper
CD-23B1	CD-51-010522	5/22/2001	<0.5	0.57	<0.5	<0.5	3.96	<0.5	upper
CD-23B1	CD-23B1-070509	5/9/2007	<0.5	0.77	<0.5	<0.5	2.71	<0.5	upper
CD-23B1	CD-23B1-120515	5/15/2012	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
CD-23C2	CD-23C2-950323	3/23/1995	1.9	7.2	<0.5	<0.5	130	0.5	lower
CD-23C2	CD-23CP-010522	5/22/2001	2.15	8.79	<0.5	<0.5	80.4	2.37	lower
CD-23C2	CD-23C2-070510	5/10/2007	2.09	9.98	<0.5	<0.5	45.2	2.43	lower
CD-23C2	CD-23C2-120517	5/17/2012	0.86	8.03	<0.5	<0.5	19.9	3.31	lower



**Colbert Landfill**  
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StationID	SampleID	SampleDate	DCA	DCE	MC	PCE	TCA	TCE	Aquifer
1573A-1	1573A-1-950330	3/30/1995	11	4.8	<0.5	<0.5	<0.5	<0.5	upper
1573A-1	1573A-1-010522	5/22/2001	1.41	<0.5	<0.5	<0.5	<0.5	<0.5	upper
1573A-1	1573A-1-070507	5/7/2007	4.92	2.09	<0.5	<0.5	8.75	1.88	upper
1573A-1	1573A-1-090414	4/14/2009	2.84	1.89	<0.5	<0.5	7.6	1.83	upper
1573A-1	1573A-1-100420	4/20/2010	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
1573A-1	1573A-1-110405	4/5/2011	4.11	2.74	<0.5	<0.5	6.07	2.04	upper
1573A-1	1573A-1-120515	5/15/2012	3.2	1.11	<0.5	<0.5	4.52	1.54	upper
1573B-2	1573B-2-950329	3/29/1995	<0.5	0.8	<0.5	<0.5	8.9	<0.5	upper
1573B-2	1573B-2-010521	5/21/2001	0.87	<0.5	<0.5	<0.5	2.39	<0.5	upper
1573B-2	1573B-2-070511	5/11/2007	<0.5	<0.5	<0.5	<0.5	1.13	<0.5	upper
1573B-2	1573B-2-120514	5/14/2012	<0.5	<0.5	<0.5	<0.5	0.85	<0.5	upper
1573B-4	1573B-4-950329	3/29/1995	<0.5	<0.5	<0.5	<0.5	1.3	<0.5	upper
1573B-4	1573B-4-010521	5/21/2001	<0.5	<0.5	<0.5	<0.5	1.31	<0.5	upper
1573B-4	1573B-4-120515	5/15/2012	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
1573H-4	1573H-4-950330	3/30/1995	7.5	4.5	<0.5	<0.5	35	<0.5	upper
1573H-4	1573H-4-010522	5/22/2001	3.83	0.72	<0.5	<0.5	<0.5	<0.5	upper
1573H-4	1573H-4-070508	5/8/2007	0.85	0.66	<0.5	<0.5	2.56	<0.5	upper
1573H-4	1573H-4-120515	5/15/2012	0.51	<0.5	<0.5	<0.5	1	<0.5	upper
CD-01C1	CD-01C2-950322	3/22/1995	21	49	5	<0.5	560	1.5	lower
CD-01C1	CD-01C1-010523	5/23/2001	12.55	23.3	<0.5	<0.5	207.4	0.83	lower
CD-01C1	CD-01C1-070510	5/10/2007	14.3	34.3	<0.5	<0.5	155	0.92	lower
CD-01C1	CD-01C1-120517	5/17/2012	12.6	46.9	<0.5	<0.5	106	0.72	lower
CD-02RA1	CD-02RA1L-020410	4/10/2002	1.01	<0.5	<0.5	1.57	1.51	1.17	upper
CD-02RA1	CD-02RA1U-020410	4/10/2002	0.96	<0.5	<0.5	1.09	1.18	1.12	upper
CD-02RA1	CD-02RA1-070508	5/8/2007	0.82	<0.5	<0.5	1	0.76	0.9	upper
CD-02RA1	HSCD-02RA1-070508	5/8/2007	<0.5	<0.5	<0.5	0.51	<0.5	0.5	upper
CD-02RA1	CD-02RA1-120516	5/16/2012	<0.5	<0.5	<0.5	0.68	<0.5	0.67	upper
CD-02RC2	CD-02RC1L-020410	4/10/2002	0.71	6.33	<0.5	<0.5	22.9	0.62	lower
CD-02RC2	CD-02RC1M-020410	4/10/2002	0.76	3.72	<0.5	<0.5	19.58	1.78	lower
CD-02RC2	CD-02RC1U-020410	4/10/2002	0.76	4.05	<0.5	<0.5	21.74	1.32	lower
CD-02RC2	CD-02RC2-070509	5/9/2007	<0.5	4.67	<0.5	<0.5	11.7	0.91	lower
CD-02RC2	CD-02RC2-120516	5/16/2012	<0.5	3.99	<0.5	<0.5	6.42	0.57	lower
CD-03C1	CD-03C1-010524	5/24/2001	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CD-03C1	CD-03C1-070507	5/7/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CD-03C1	CD-03C1-120514	5/14/2012	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
CD-04C1	CD-04C1-960710	7/10/1996	75	29	<0.5	<0.5	13	1.1	lower
CD-04C1	CD-04C1-010524	5/24/2001	135.1	0.58	0.79	<0.5	0.61	0.73	lower
CD-04C1	CD-04C1P-010524	5/24/2001	50.9	4.76	0.96	<0.5	1.27	1.07	lower
CD-04C1	CD-04C1-070511	5/11/2007	39	3.87	<0.5	<0.5	<0.5	0.96	lower
CD-04C1	CD-04C1-120517	5/17/2012	35.3	2.21	<0.5	<0.5	<0.5	0.64	lower



**Colbert Landfill**  
**Summary of All Supplemental Sampling**  
**Constituent of Concern Concentrations**  
**from 1995 to 2012 (ppb)**

StationID	SampleID	SampleDate	DCA	DCE	MC	PCE	TCA	TCE	Aquifer
0273D-2	0273D-2-120516	5/16/2012	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
0273E-1	0273E-1-010521	5/21/2001	<0.5	2.43	<0.5	<0.5	13.32	<0.5	lower
0273E-3	0273E-3-010521	5/21/2001	<0.5	3.53	<0.5	<0.5	17.61	<0.5	lower
0273E-3	0273E-3-070511	5/11/2007	<0.5	<0.5	<0.5	<0.5	1.1	<0.5	lower
0273E-3	CD-52-070511	5/11/2007	<0.5	<0.5	<0.5	<0.5	1.15	<0.5	lower
0273E-3	0273E-3-120514	5/14/2012	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
0273L-2	0273L-2-010523	5/23/2001	7.25	24.5	<0.5	<0.5	20.2	<0.5	lower
0273L-2	0273L-2-070509	5/9/2007	4.63	24.9	<0.5	<0.5	11.3	<0.5	lower
0273L-2	0273L-2-120516	5/16/2012	2.37	11.6	<0.5	<0.5	3.62	<0.5	lower
0273N-7	0273N-7-950327	3/27/1995	27	9.6	<0.5	1	43	6.1	lower
0273N-7	0273N-7-010524	5/24/2001	5.9	12.51	<0.5	<0.5	22.4	2.27	lower
0273N-7	0273N-7-070509	5/9/2007	5.14	6.45	<0.5	<0.5	11	2.59	lower
0273N-7	0273N-7-120517	5/17/2012	1.9	3.91	<0.5	<0.5	3.38	2.21	lower
0273P-3	0273P-3-010521	5/21/2001	<0.5	1.34	<0.5	<0.5	4.84	<0.5	lower
0273P-3	0273P-3-070507	5/7/2007	<0.5	0.87	<0.5	<0.5	1.96	<0.5	lower
0273P-3	0273P-3-120515	5/15/2012	<0.5	0.55	<0.5	<0.5	0.8	<0.5	lower
0373J-3	0373J-3-070514	5/14/2007	1.89	7.29	<0.5	<0.5	33.4	<0.5	lower
0373J-3	CD-54-070514	5/14/2007	1.88	7.09	<0.5	<0.5	32.3	<0.5	lower
0373J-5	0373J-5-010521	5/21/2001	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	lower
0373P-1S	0373P-1S-950328	3/28/1995	<0.5	<0.5	<0.5	0.5	11	<0.5	spring
0373P-1S	0373P-1S-010521	5/21/2001	<0.5	<0.5	<0.5	<0.5	1.85	<0.5	spring
0373P-1S	0373P-1S-070511	5/11/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	spring
0373P-1S	0373P-1S-120514	5/14/2012	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	spring
1073C-1S	1073C-1S-950329	3/29/1995	<0.5	<0.5	<0.5	<0.5	2.2	<0.5	spring
1073C-1S	1073C-1S-010521	5/21/2001	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	spring
1073C-1S	1073C-1S-070511	5/11/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	spring
1073C-1S	1073C-1S-120514	5/14/2012	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	spring
1073K-1	1073K-1-950329	3/29/1995	5.3	2.2	<0.5	2.5	18	1.5	upper
1073K-1	1073K-1-010521	5/21/2001	1.55	0.89	<0.5	0.66	4.24	0.72	upper
1073K-1	1073K-1-070511	5/11/2007	0.73	1.03	<0.5	0.6	2.03	0.78	upper
1073K-1	1073K-1-120515	5/15/2012	0.64	0.54	<0.5	<0.5	1.37	0.8	upper
1073K-1	CD-50-120515	5/15/2012	0.61	0.53	<0.5	<0.5	1.42	0.85	upper
1073Q-2	1073Q-2-950331	3/31/1995	3.9	1.5	<0.5	<0.5	20	<0.5	upper
1073Q-2	1073Q-2-010523	5/23/2001	1.61	0.71	<0.5	<0.5	4.69	<0.5	upper
1073Q-2	1073Q-2-070514	5/14/2007	0.64	0.78	<0.5	<0.5	2.71	<0.5	upper
1073Q-2	1073Q-2-120516	5/16/2012	<0.5	<0.5	<0.5	<0.5	1.11	<0.5	upper
1173D-1	1173D-1-010523	5/23/2001	13.13	3.17	<0.5	<0.5	5.55	10.52	lower
1173D-1	1173D-1-070508	5/8/2007	14.8	1.91	<0.5	<0.5	2.76	9.39	lower
1173L-1	1173L-1-010524	5/24/2001	<0.5	<0.5	<0.5	<0.5	3	<0.5	lower
1473N-1	1473N-1-950330	3/30/1995	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
1473N-1	1473N-1-010522	5/22/2001	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
1473N-1	1473N-1-070507	5/7/2007	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
1473N-1	1473N-1-120514	5/14/2012	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper



**Table 5-3 Supplemental Well Analytical Results**

StationID	SampleDate	DCA	DCE	MC	PCE	TCA	TCE	Aquifer
0273D-2	4/27/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	low er
0273E-3	4/26/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	low er
0273L-2	5/3/17	2.74	10.5	<0.5	<0.5	2.21	<0.5	low er
0273N-7	5/3/17	1.37	4.37	<0.5	<0.5	2.53	2.24	low er
0273P-3	4/26/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	low er
0373P-1S	4/25/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
1073C-1S	4/25/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
1073Q-2	5/4/17	<0.5	<0.5	<0.5	<0.5	0.91	<0.5	upper
1573B-4	4/26/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
1573H-1	4/26/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	low er
1573H-4	5/1/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
CD-01C1	5/3/17	6.32	53	<0.5	<0.5	56.9	<0.5	low er
CD-02RA1	5/1/17	0.59	<0.5	<0.5	0.58	<0.5	0.68	upper
CD-02RC2	5/2/17	0.53	3.88	<0.5	<0.5	9.86	1.39	low er
CD-03C1	4/27/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	low er
CD-04C1	5/4/17	276	372	<0.5	2.26	44.4	13.7	low er
CD-04E1	5/4/17	241	326	<0.5	2.26	36.4	13.4	low er
CD-05C2	4/26/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	low er
CD-06A1	5/3/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
CD-06C2	5/2/17	<0.5	<0.5	<0.5	<0.5	0.71	<0.5	low er
CD-07E1	4/27/17	<0.5	1.87	<0.5	<0.5	<0.5	<0.5	low er
CD-08E1	5/2/17	3.76	32.6	<0.5	<0.5	10.2	6.49	low er
CD-21C1	5/1/17	2.34	5.72	<0.5	<0.5	23	<0.5	low er
CD-22D1	4/27/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	low er
CD-23B1	5/2/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
CD-23C2	5/3/17	<0.5	4.95	<0.5	<0.5	5.49	<0.5	low er
CD-24C2	5/2/17	4.35	6.88	<0.5	<0.5	8.24	1.27	low er
CD-26	5/2/17	8.65	18.9	<0.5	<0.5	41.3	67.6	low er
CD-35A1	4/26/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	upper
CD-40C2	5/1/17	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	low er
CD-46	5/2/17	14.6	30.2	<0.5	<0.5	50.7	31.9	low er
CD-47	5/1/17	<0.5	4.16	<0.5	<0.5	5.46	<0.5	low er
CS-14C1	4/25/17	<0.5	2.62	<0.5	<0.5	2.55	<0.5	low er

**Figure 2-4 Lower Aquifer Monitoring Well COC Concentrations**

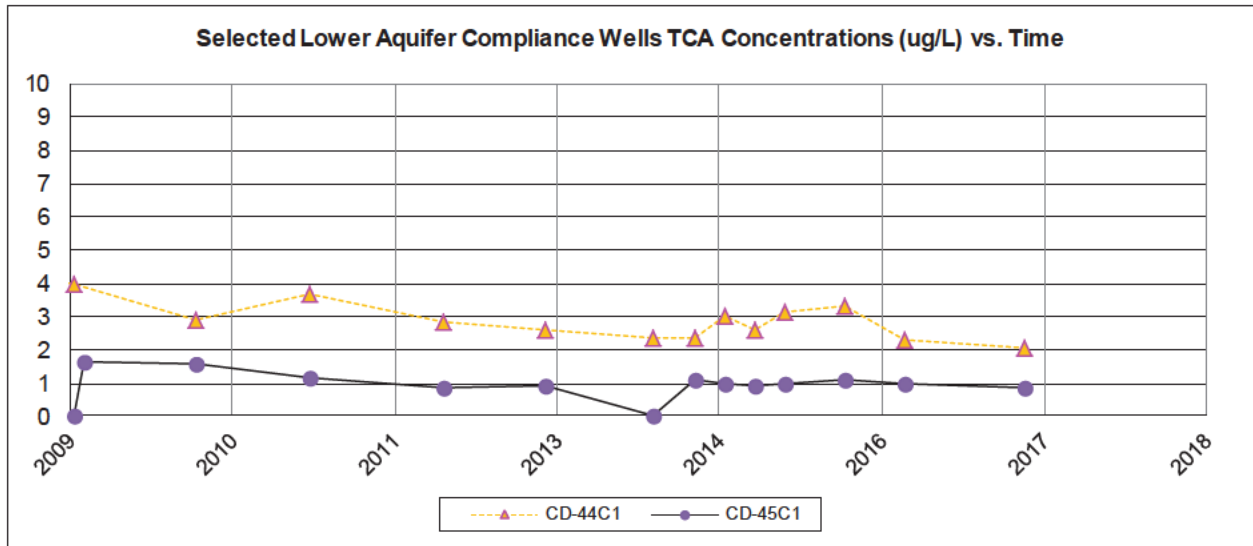
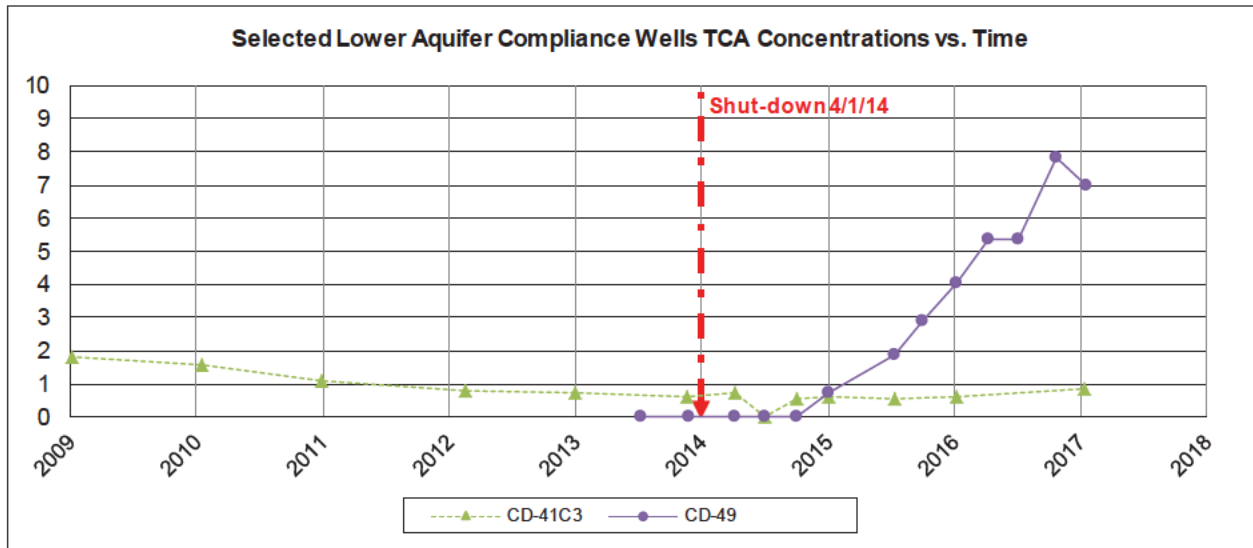


Figure 2-5 Lower Aquifer Extraction Well COC Concentrations

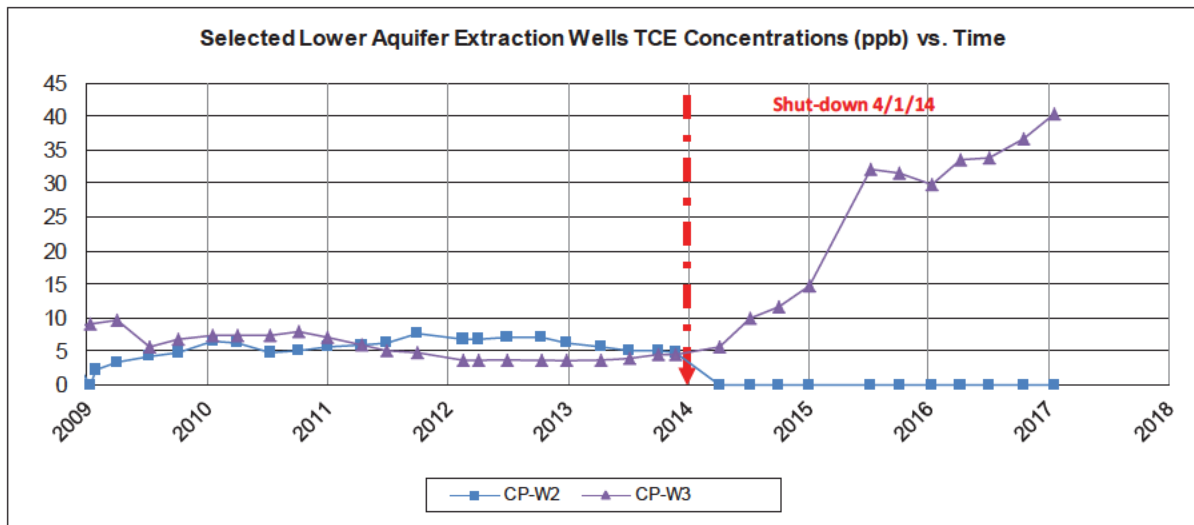
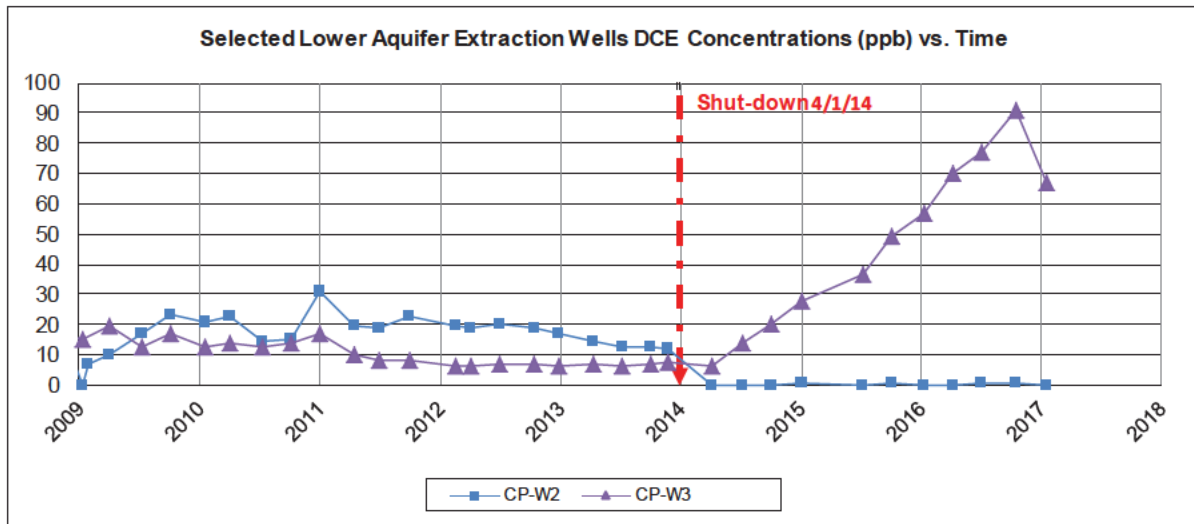
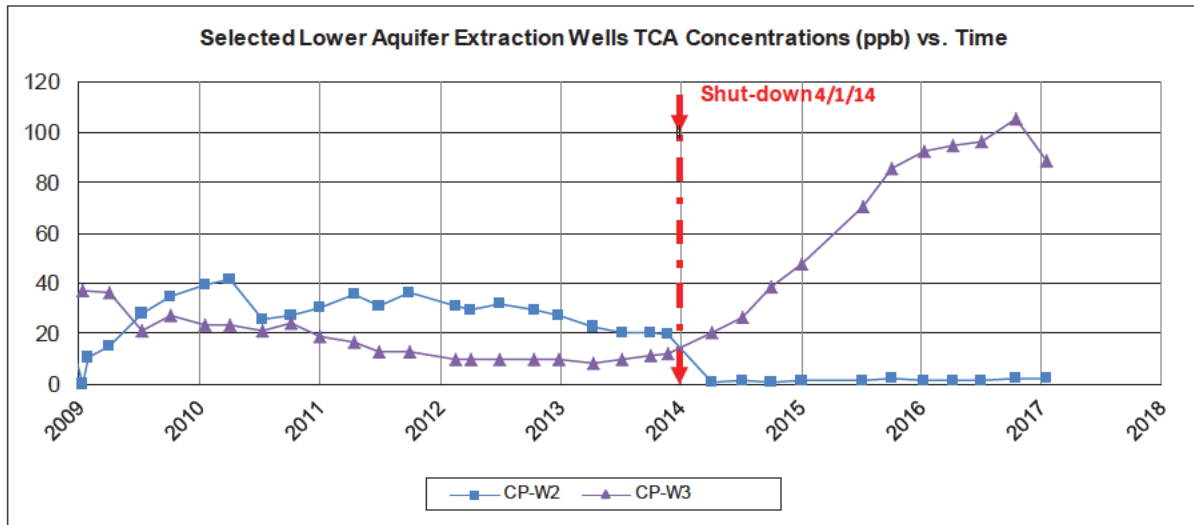


Figure 2-6 Lower Aquifer Extraction Well COC Concentrations

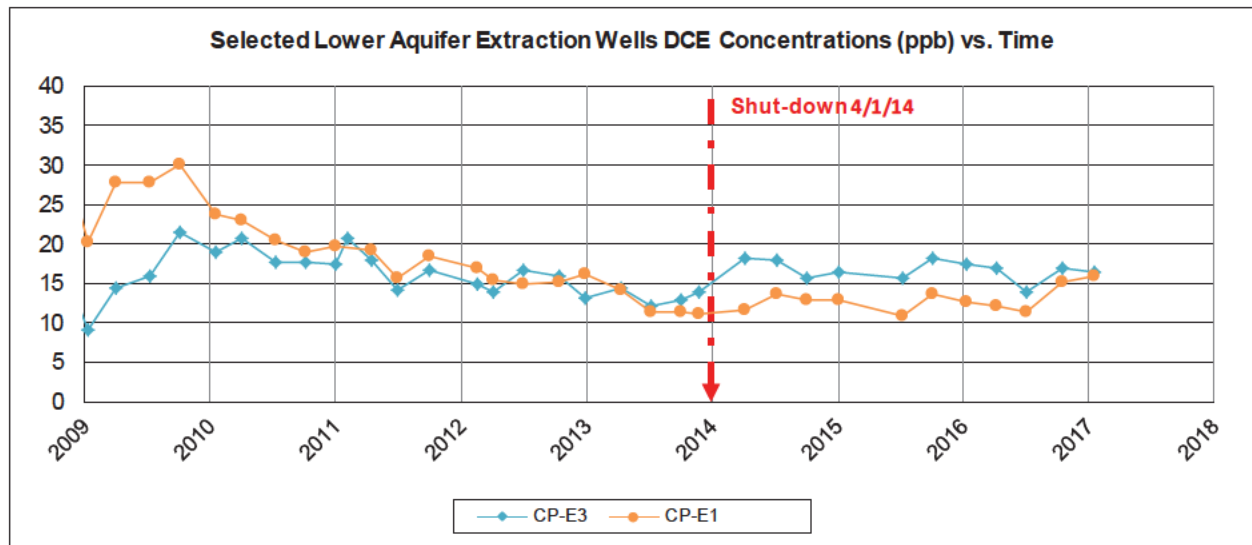
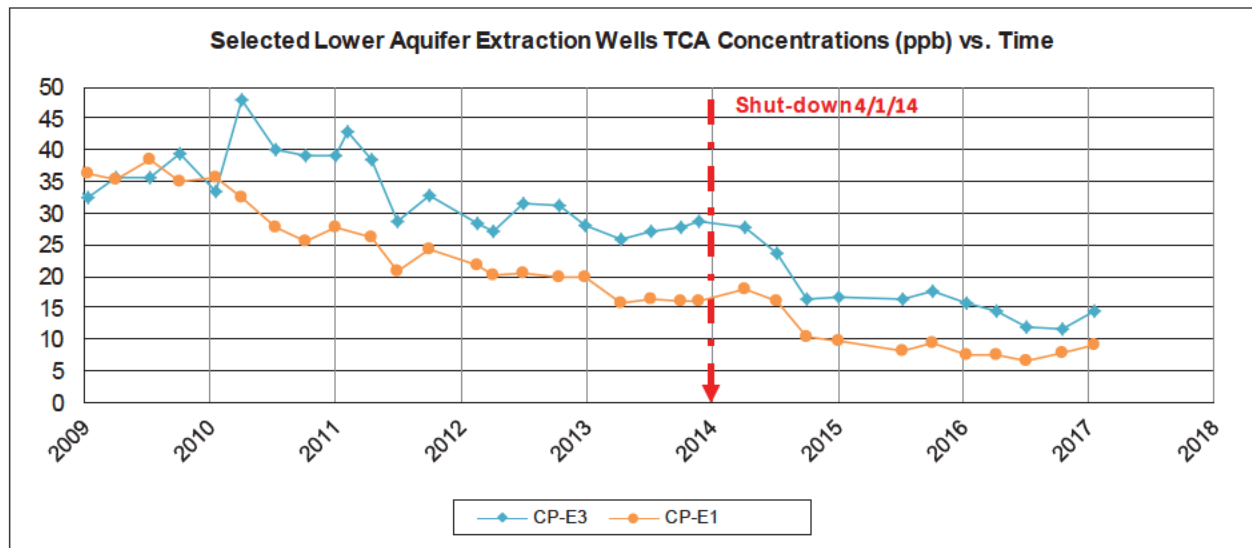
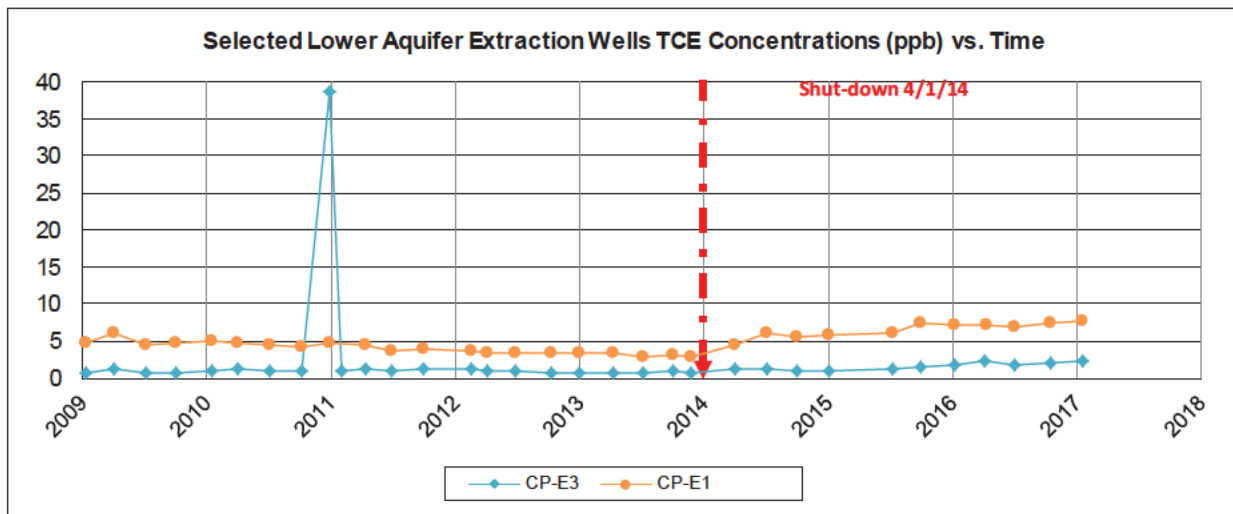
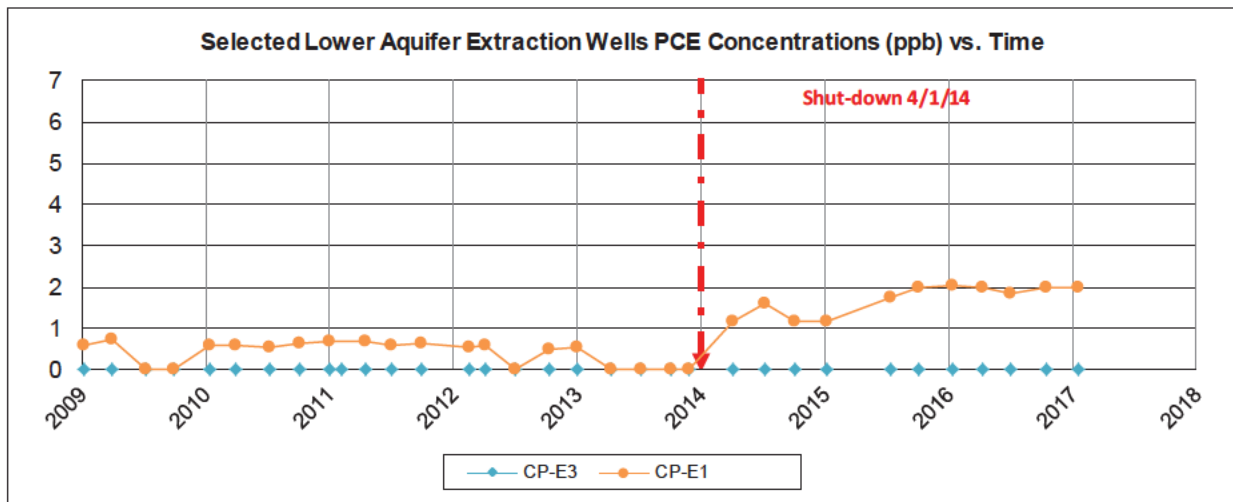
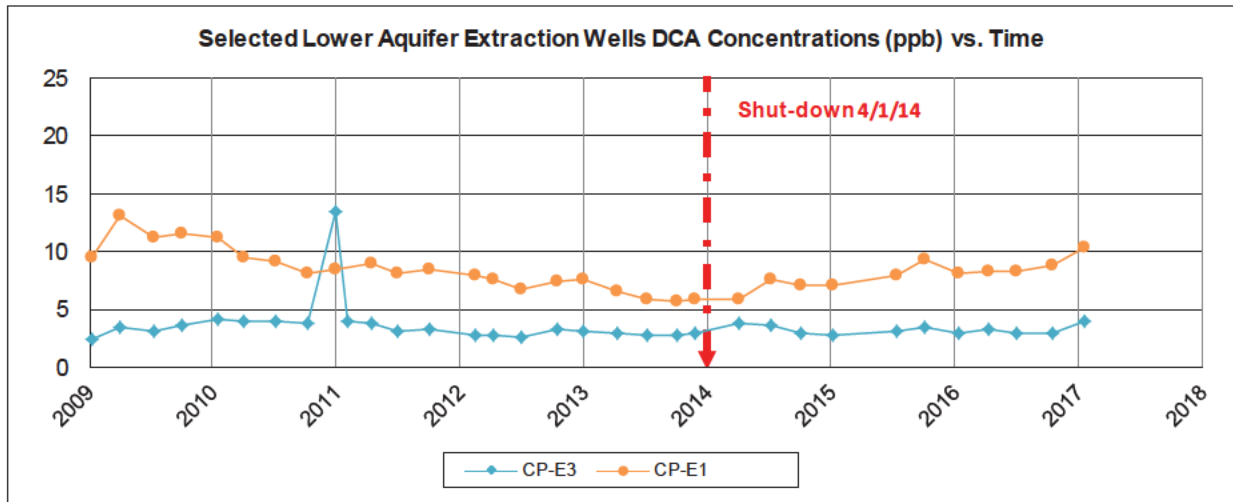




Figure 2-7 Lower Aquifer Extraction Well Concentrations



Attachment 8. 1,4-Dioxane Data

Well ID	Aquifer	Date	1,4-Dioxane (ug/L)
<b>MTCA Method B</b>			
<b>Groundwater Cleanup Level</b>			<b>4</b>
0273E-3	lower	5/11/2007	2 U
0273C-4	lower	2/7/2006	5 U
0273F-4	lower	10/4/2005	5 U
0273L-2	lower	5/9/2007	2 U
0273N-7	lower	5/9/2007	2 U
0273P-3	lower	5/7/2007	2 U
0373A-2	lower	10/4/2005	5 U
0373A-4	lower	10/4/2005	5 U
0373J-3	lower	5/14/2007	2 U
0373L-1	upper	11/2/2005	5 U
0373P-1S	upper	5/11/2007	2 U
1073C-1S	upper	5/11/2007	2 U
1073D-1*	upper	9/14/2005	5 UJ
1073D-1*	upper	2/8/2006	5 U
1073D-1*	upper	5/11/2007	<b>2.4</b>
1073D-1*	upper	4/8/2008	<b>2.2</b>
1073D-1*	upper	7/8/2008	2 U
1073D-2*	upper	7/20/2005	<b>11.3</b>
1073D-2*	upper	9/14/2005	<b>11.1 J</b>
1073D-2*	upper	10/5/2005	<b>13.8</b>
1073D-2*	upper	5/22/2007	<b>3.3</b>
1073D-2*	upper	4/8/2008	<b>2.9</b>
1073D-2*	upper	7/8/2008	<b>2.3</b>
1073G-1	lower	10/4/2005	5 U
1073J-1	lower	1/10/2006	5 U
1073J-2	lower	9/14/2005	5 UJ
1073K-1	upper	5/11/2007	2 U
1073L-1	upper	10/4/2005	5 U
1073L-2	upper	10/4/2005	5 U
1073L-3	upper	10/4/2005	5 U
1073L-4	lower	10/4/2005	5 U
1073P-2	upper	10/4/2005	5 U
1073Q-2	upper	5/14/2007	2 U
1073Q-4	lower	9/14/2005	5 UJ
1173D-1	lower	5/8/2007	2 U
1473C-3	lower	3/23/2006	5 U
1473D-1	lower	10/4/2005	5 U
1473D-2	upper	11/2/2005	5 U
1473M-1*	upper	10/5/2005	5 U
1473M-1*	upper	4/8/2008	2 U
1473M-1*	upper	7/8/2008	2 U
1473N-1	upper	5/7/2007	2 U
1573A-1*	upper	5/7/2007	<b>4.9</b>
1573A-1*	upper	7/8/2008	2 U
1573B-2	upper	5/11/2007	2 U
1573C-8	upper	2/8/2006	5 U
1573H-1	lower	10/4/2005	5 U
1573H-4	upper	5/8/2007	2 U
1573K-1	upper	10/5/2005	5 U
1573R-1	upper	10/4/2005	5 U

Attachment 8. 1,4-Dioxane Data

Well ID	Aquifer	Date	1,4-Dioxane (ug/L)
<b>MTCA Method B</b>			
<b>Groundwater Cleanup Level</b>			<b>4</b>
CD-01C1	lower	5/10/2007	2 U
CD-02RA1	upper	5/8/2007	2 U
CD-02RC2	lower	5/9/2007	2 U
CD-03A1	upper	5/15/2007	2 U
CD-03C1	lower	5/7/2007	2 U
CD-04C1	upper	5/11/2007	<b>96 E</b>
CD-04E1	lower	5/11/2007	<b>41</b>
CD-05C2	lower	5/7/2007	2 U
CD-06A1	upper	5/9/2007	2 U
CD-06C2	lower	5/9/2007	2 U
CD-07E1	lower	5/9/2007	2 U
CD-08E1	lower	5/10/2007	2 U
CD-21C1	lower	5/10/2007	2 U
CD-22D1	lower	5/7/2007	2 U
CD-23B1	upper	5/9/2007	2 U
CD-23C2	lower	5/10/2007	2 U
CD-24C2	lower	5/8/2007	2 U
CD-26	lower	5/10/2007	2 U
CD-31A1	upper	5/15/2007	2 U
CD-32B1	upper	5/7/2007	2 U
CD-34A1	upper	5/15/2007	2 U
CD-35A1	upper	5/7/2007	2 U
CD-36A1	upper	5/15/2007	2 U
CD-37A1	upper	5/16/2007	2 U
CD-37A1	upper	5/16/2007	2 U
CD-38A1	upper	5/15/2007	2 U
CD-40C1*	lower	9/14/2005	<b>23.9 J</b>
CD-40C1*	lower	5/16/2007	<b>11</b>
CD-40C1*	lower	4/8/2008	<b>13</b>
CD-40C1*	lower	7/8/2008	<b>11</b>
CD-40C2	lower	9/14/2005	<b>8.8 J</b>
CD-40C2	lower	5/8/2007	2 U
CD-40C3	lower	9/14/2005	5 UJ
CD-41C1	lower	5/14/2007	2 U
CD-41C2	lower	5/14/2007	2 U
CD-41C3	lower	5/14/2007	2 U
CD-42C1	lower	5/14/2007	2 U
CD-42C2	lower	5/14/2007	2 U
CD-42C3	lower	5/14/2007	2 U
CD-43C1	lower	5/14/2007	2 U
CD-43C2	lower	5/14/2007	2 U
CD-43C3	lower	5/14/2007	2 U
CD-44C1	lower	7/20/2005	5 U
CD-44C1	lower	5/15/2007	2 U
CD-44C2	lower	5/15/2007	2 U
CD-44C3	lower	5/14/2007	2 U
CD-45C1	lower	5/15/2007	2 U
CD-45C2	lower	5/15/2007	2 U
CD-45C3	lower	5/15/2007	2 U
CD-46	lower	5/8/2007	2 U

## Attachment 8. 1,4-Dioxane Data

Well ID	Aquifer	Date	1,4-Dioxane (ug/L)
<b>MTCA Method B</b>			
<b>Groundwater Cleanup Level</b>			<b>4</b>
CD-47	lower	5/10/2007	2 U
CD-47	lower	5/10/2007	2 U
CD-48C1	lower	5/15/2007	2 U
CD-48C2	lower	5/15/2007	2 U
CD-48C3	lower	5/15/2007	2 U
CD-60A1	upper	5/15/2007	2 U
CD-61A1	upper	5/14/2007	2 U
CP-E1	lower	7/20/2005	5 U
CP-E2	lower	10/6/2005	5 U
CP-E3	lower	5/16/2007	2 U
CP-S1*	upper	7/19/2005	<b>25.8</b>
CP-S1*	upper	9/14/2005	<b>30 J</b>
CP-S1*	upper	4/9/2008	<b>9.4</b>
CP-S1*	upper	7/8/2008	<b>15</b>
CP-S3	upper	5/14/2007	2 U
CP-S4	upper	10/6/2005	5 U
CP-S5	upper	10/6/2005	5 U
CP-S6	upper	10/6/2005	5 U
CP-W1	lower	5/16/2007	2 U
CP-W2	lower	7/20/2005	<b>6.3</b>
CP-W2	lower	9/14/2005	<b>11.1 J</b>
CP-W2	lower	5/16/2007	2 U
CP-W3	lower	10/6/2005	5 U
CS-04A1	upper	5/15/2007	2 U
CS-14C1	upper	5/8/2007	2 U

Notes:

Bold indicates a detected concentration

Highlight indicates detected concentration above Performance Criteria

\* Included in quarterly sampling program



**Table 3-5 1,4-Dioxane Monitoring Results**

<b>Aquifer</b>	<b>StationID</b>	<b>SampleDate</b>	<b>Analyte</b>	<b>Result</b>	<b>Qualifier</b>	<b>Units</b>
upper	1073D-1	4/13/2016	1,4-Dioxane		U	ug/L
upper	1473M-1	4/13/2016	1,4-Dioxane		U	ug/L
lower	CD-40C1	4/13/2016	1,4-Dioxane	7.7		ug/L
lower	CD-40C1	4/13/2016	1,4-Dioxane	7.1		ug/L
upper	CP-S1	4/13/2016	1,4-Dioxane	5.8		ug/L

**Table 2-4 Upper Aquifer Groundwater Monitoring Results**

StationID	SampleDate	TCA	DCA	DCE	PCE	TCE	MC	Cl	COD	Fe	Mn	NO3	SO4	TOC	Zn
1073D-1	4/8/2015	0.51	<0.5	<0.5	<0.5	<0.5	<0.5								
1573A-1	4/8/2015	1.91	0.93	0.68	<0.5	0.73	<0.5								
CD-03A1	4/9/2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.74	<5	<0.06	<0.004		6.75	<1	<0.01
CD-31A1	4/7/2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5								
CD-34A1	4/7/2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5								
CD-36A1	4/7/2015	<0.5	13.5	1.08	<0.5	<0.5	<0.5								
CD-37A1	4/7/2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5								
CD-38A1	4/7/2015	0.52	<0.5	<0.5	<0.5	<0.5	<0.5								
CD-60A1	4/9/2015	<0.5	<0.5	<0.5	<0.5	0.5	<0.5	6.43	<5	<0.06	<0.004		10.4	<1	<0.01
CD-61A1	4/9/2015	3.3	<0.5	<0.5	<0.5	<0.5	<0.5	0.75	<5	<0.06	<0.004		9.61	<1	<0.01
CP-S1	4/8/2015	1.32	1.34	<0.5	<0.5	1.39	<0.5								
CP-S3	4/7/2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5								
CP-S4	4/8/2015	0.95	1.85	<0.5	0.51	2.05	<0.5								
CP-S5	4/8/2015	0.51	<0.5	<0.5	<0.5	<0.5	<0.5								
CP-S6	4/8/2015	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5								
CD-40C1	4/9/2015	6.44	3.51	2.38	<0.5	<0.5	<0.5								

**Table 2-5 1,4-Dioxane Monitoring Results**

Aquifer	StationID	Date	Analyte	Result	Qualifier	Units
lower	CD-40C1	4/9/2015	1,4-Dioxane	7.8		ug/L
lower	CD-40C1	4/9/2015	1,4-Dioxane	5.6		ug/L
upper	1073D-1	4/8/2015	1,4-Dioxane	2	U	ug/L
upper	1473M-1	4/8/2015	1,4-Dioxane	2	U	ug/L
upper	1573A-1	4/8/2015	1,4-Dioxane	2	U	ug/L

**APPENDIX C:**

**TIME SERIES PLOTS PROVIDED BY SPOKANE COUNTY AS  
PART OF THE COMMENTS ON THE DRAFT REPORT**

## Appendix A. List of Figures

Figure 1. COC Concentrations at CD-04E1.

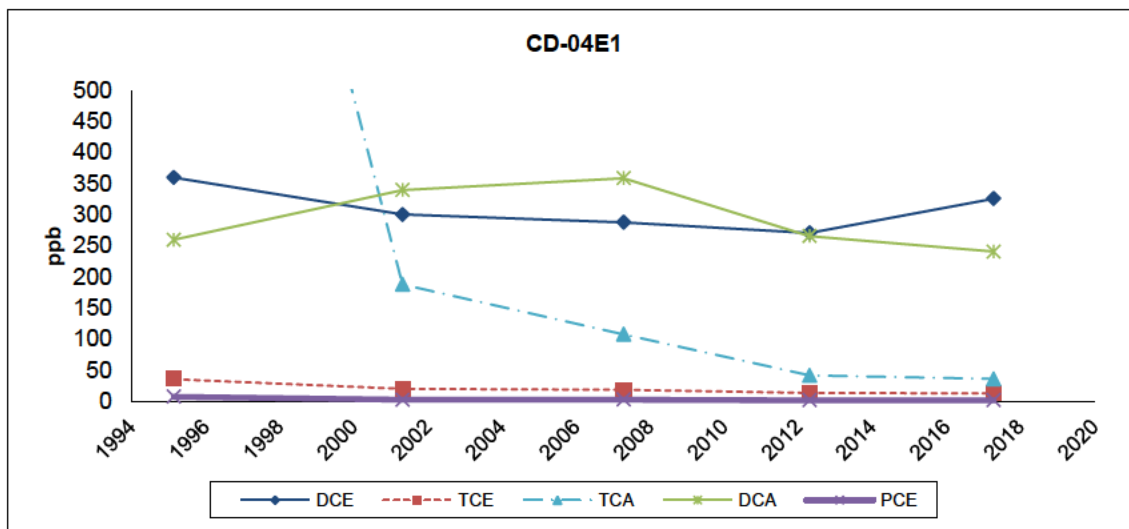


Figure 2. COC Concentrations at CD-04C1 (laboratory error included).

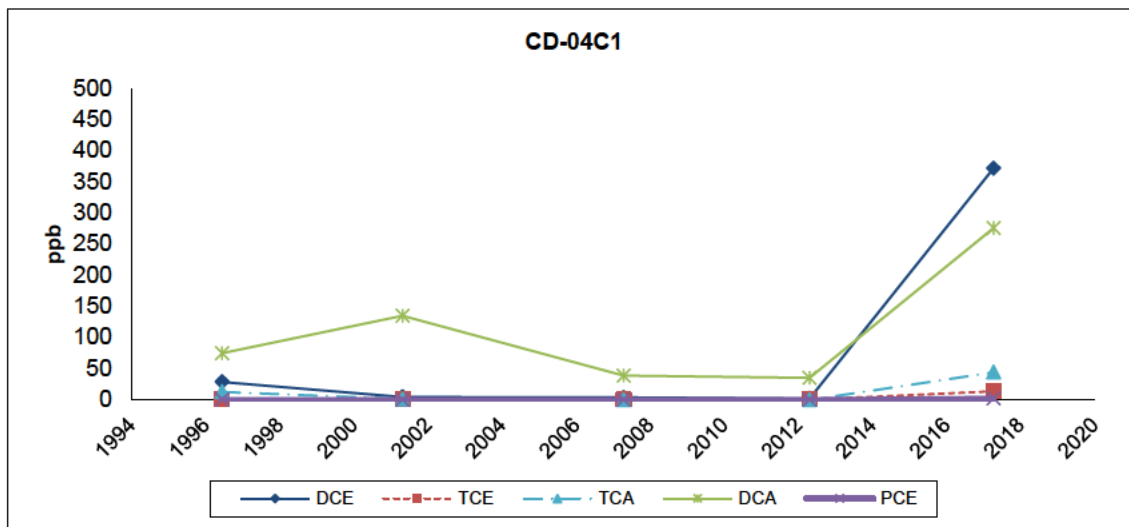


Figure 3. COC Concentrations at CD-04C1 (corrected laboratory error).



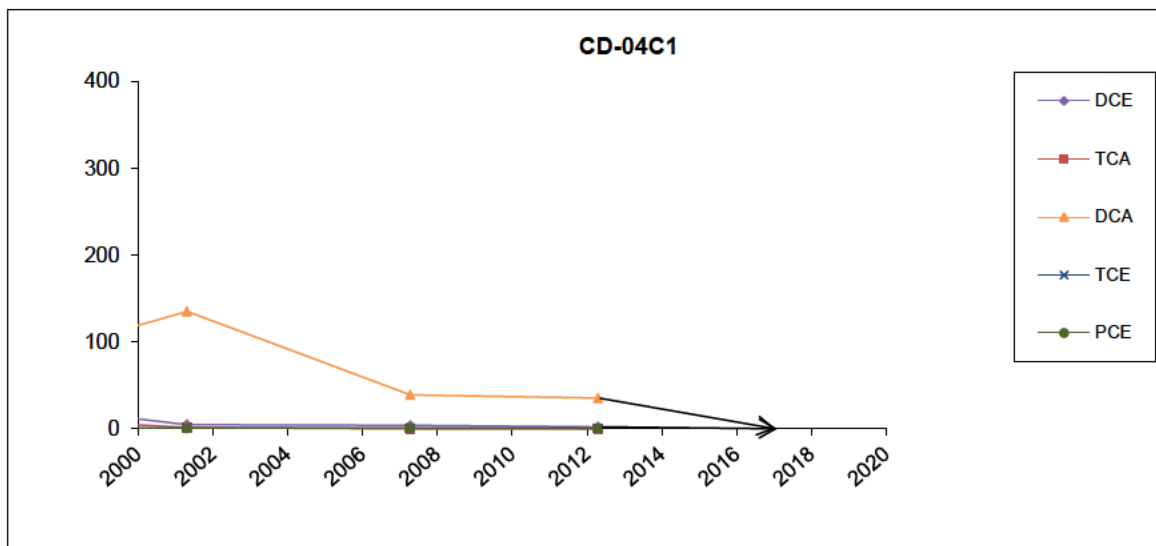


Figure 4. COC Concentrations at 1073C-1S.

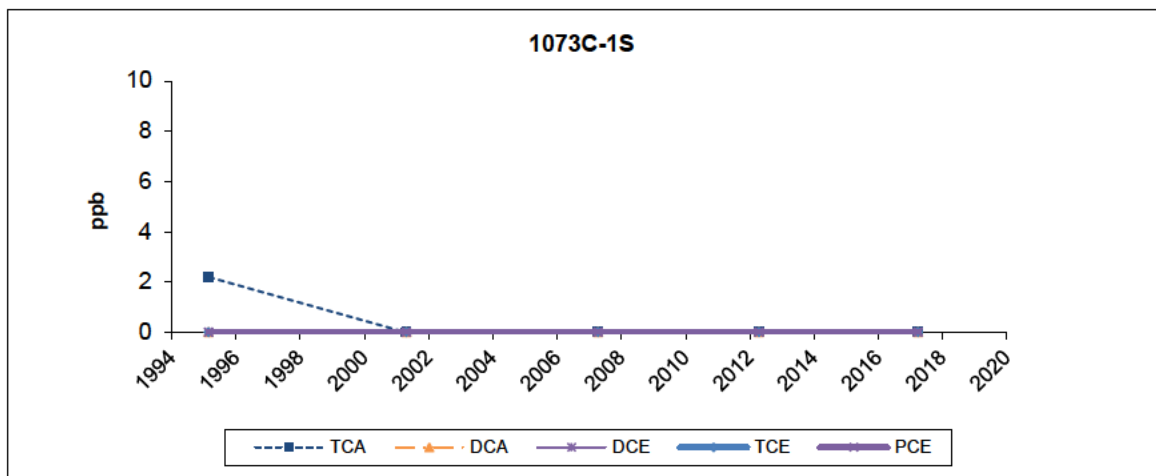


Figure 5. COC Concentrations at 0373P-1S.

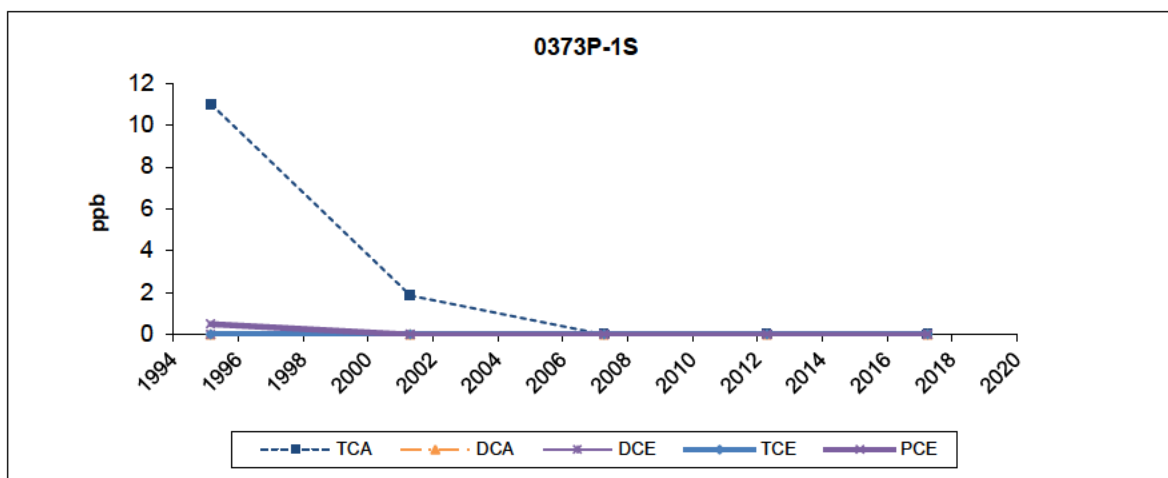


Figure 6. COC Concentrations at 0373L-1.

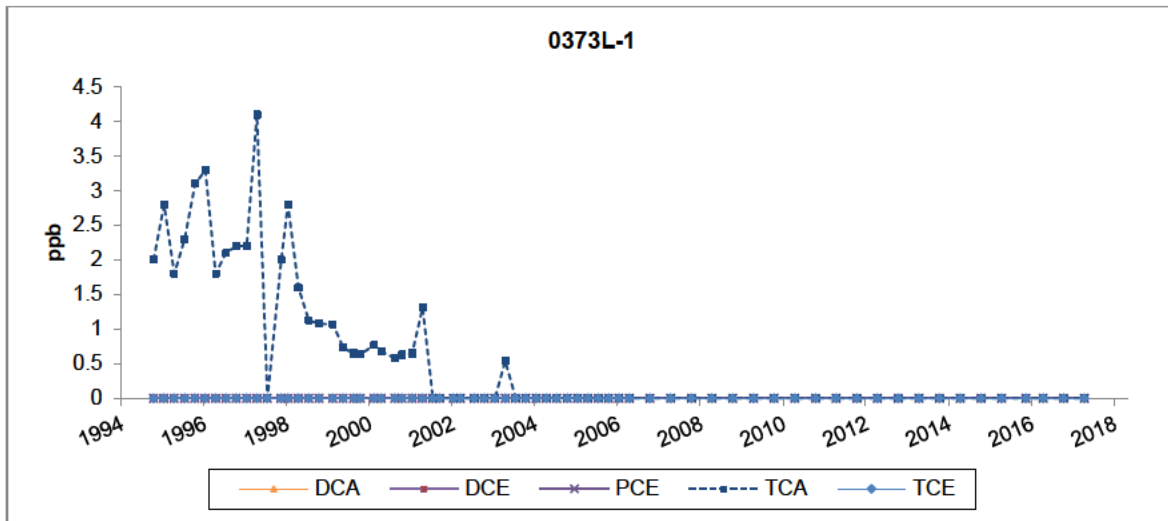


Figure 7. COC Concentrations at CP-E1.

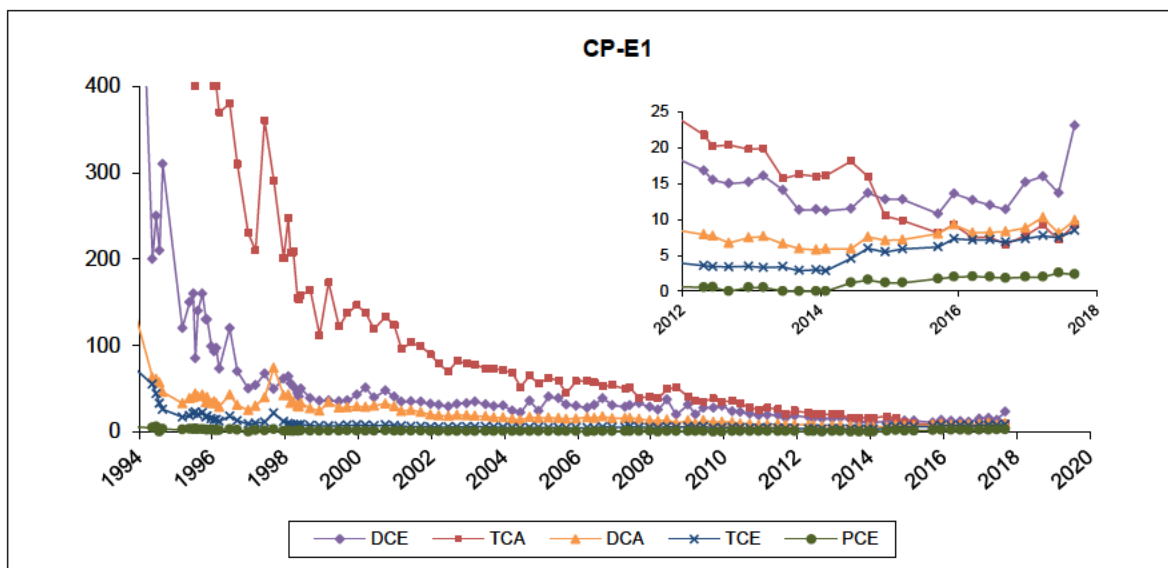


Figure 8. COC Concentrations at CP-E2.

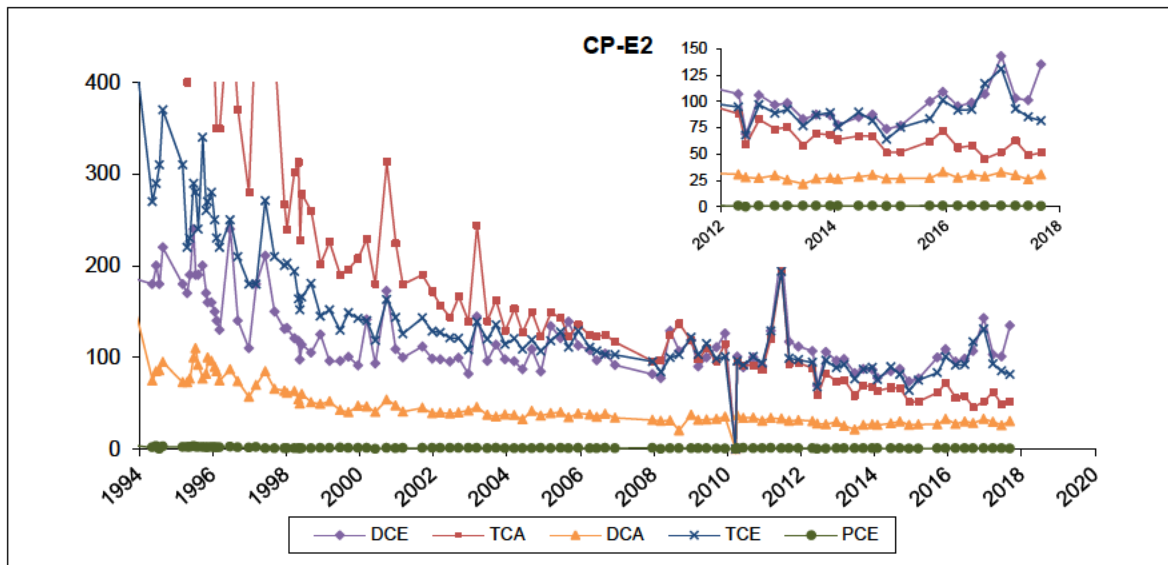


Figure 9. COC Concentrations at CD-01C1.

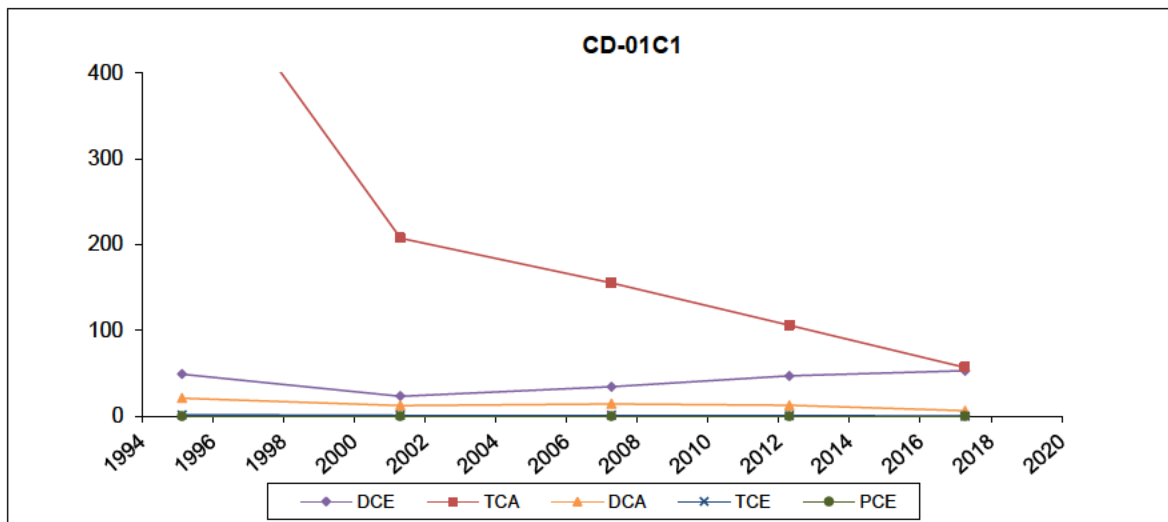


Figure 10. COC Concentrations at CP-E3.

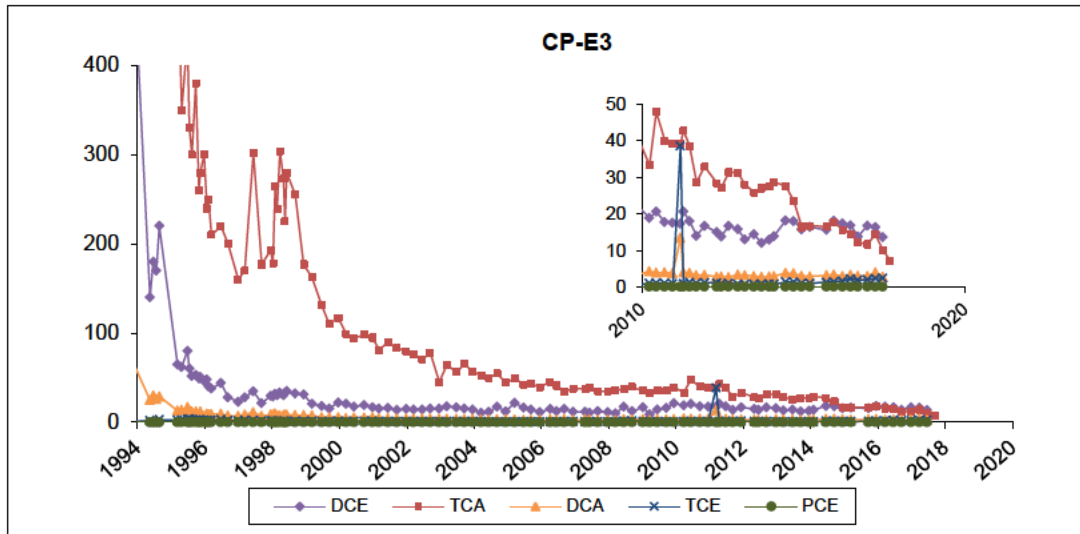


Figure 11. COC Concentrations at CD-08E1.

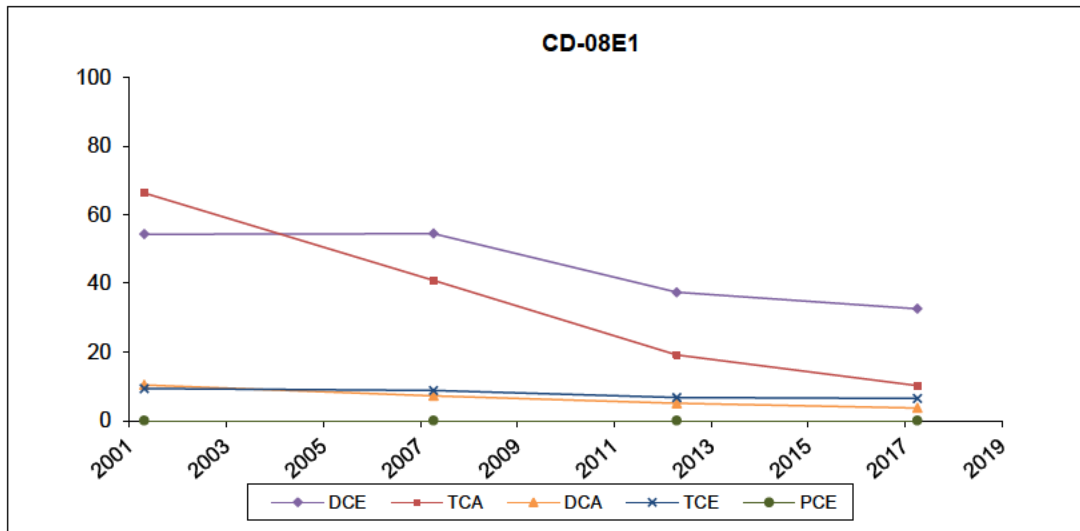


Figure 12. COC Concentrations at CP-W2.



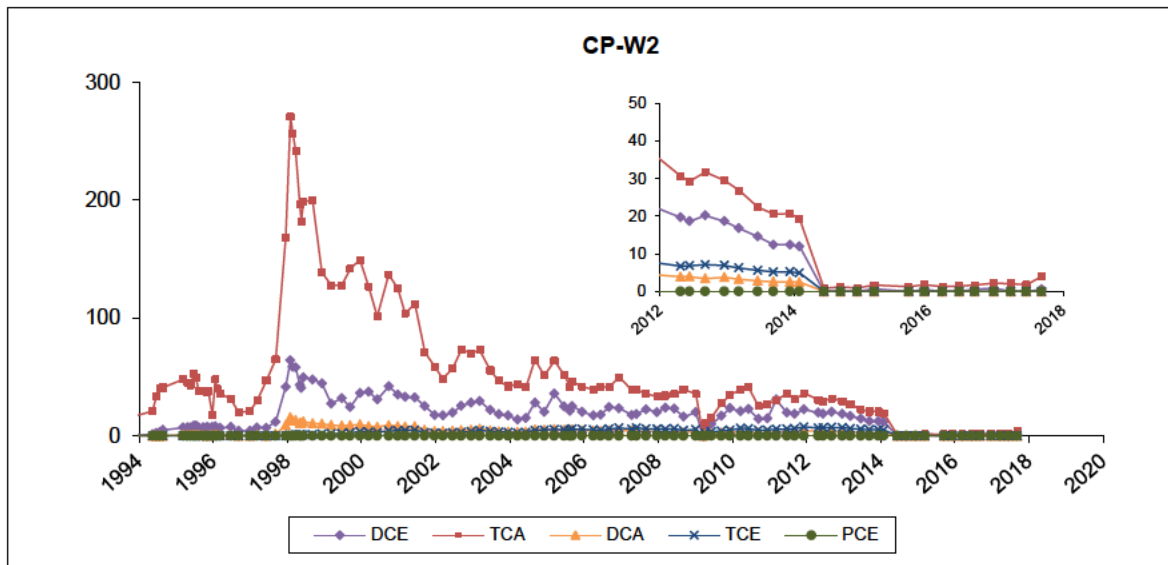


Figure 13. COC Concentrations at 0273L-2.

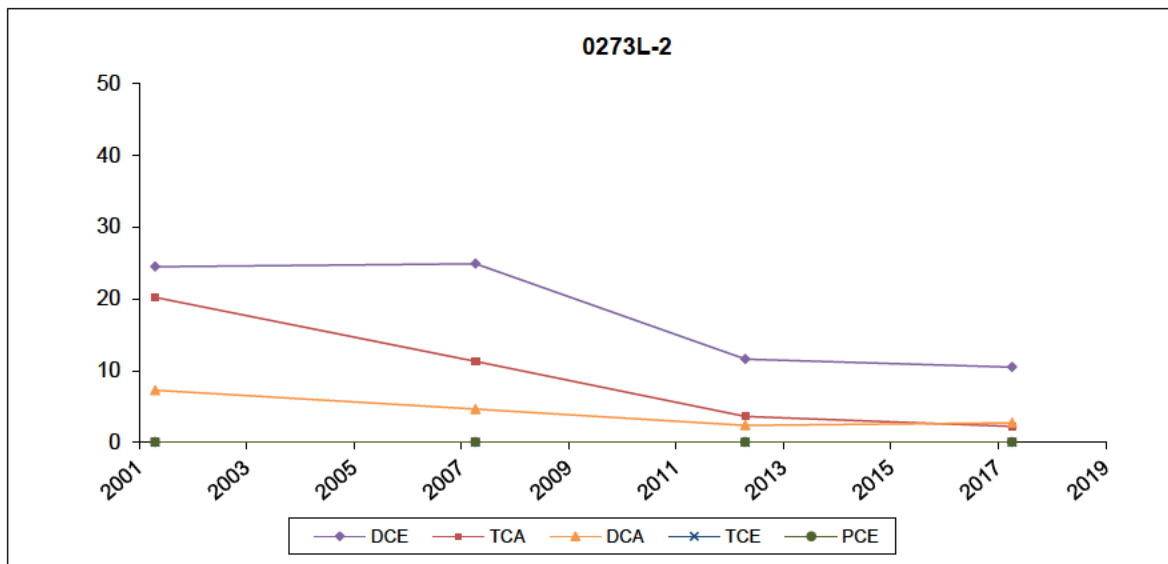


Figure 14. COC Concentrations at CD-26.

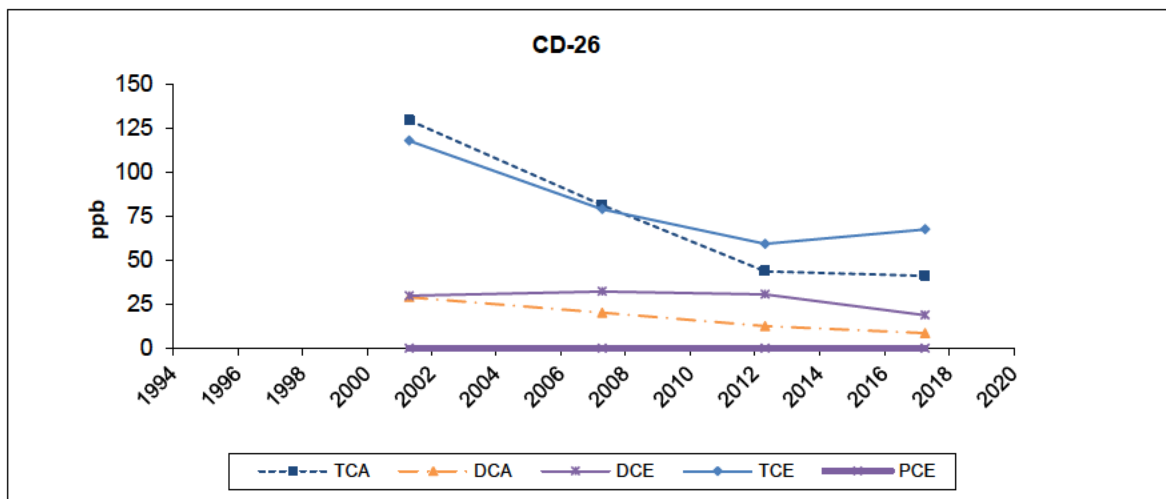


Figure 15. COC Concentrations at CD-23C2.

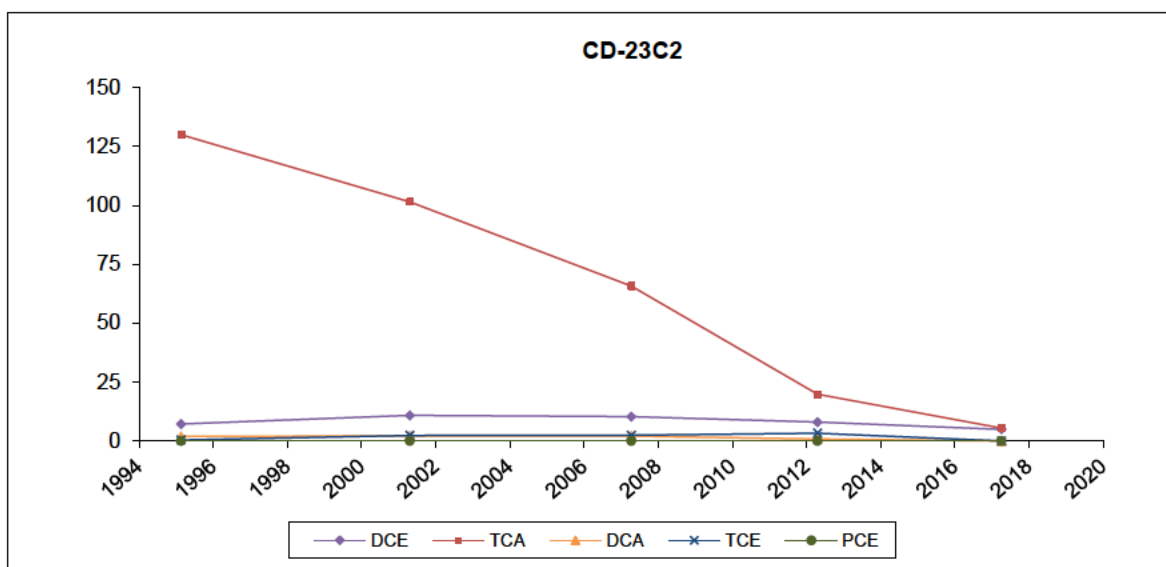


Figure 16. COC Concentrations at CD-49.

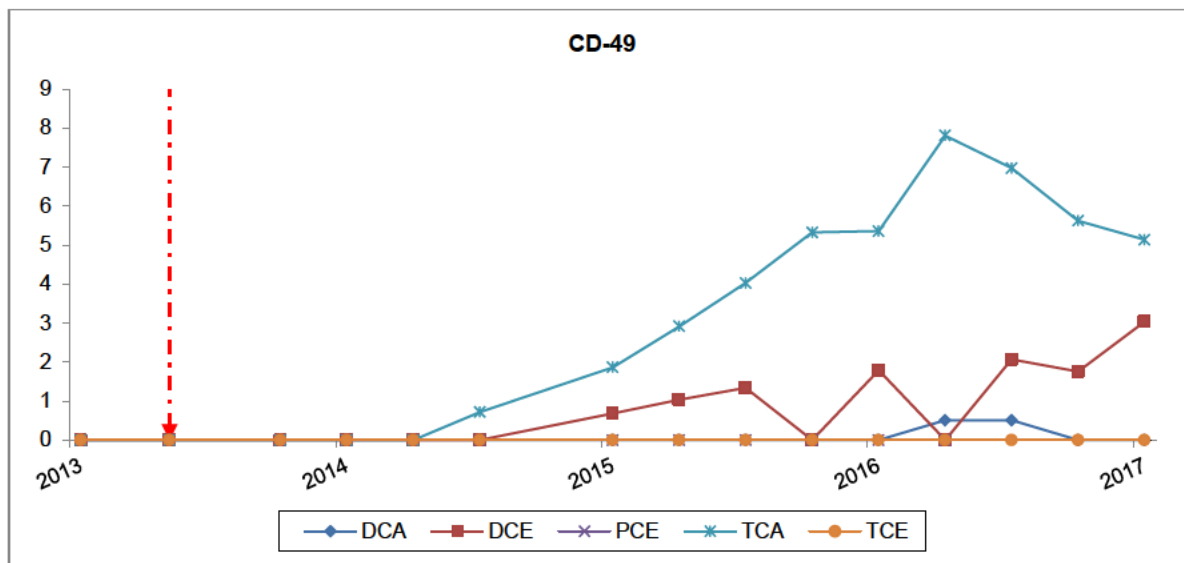


Figure 17. DCE Concentrations for CP-W3 and CD-49.

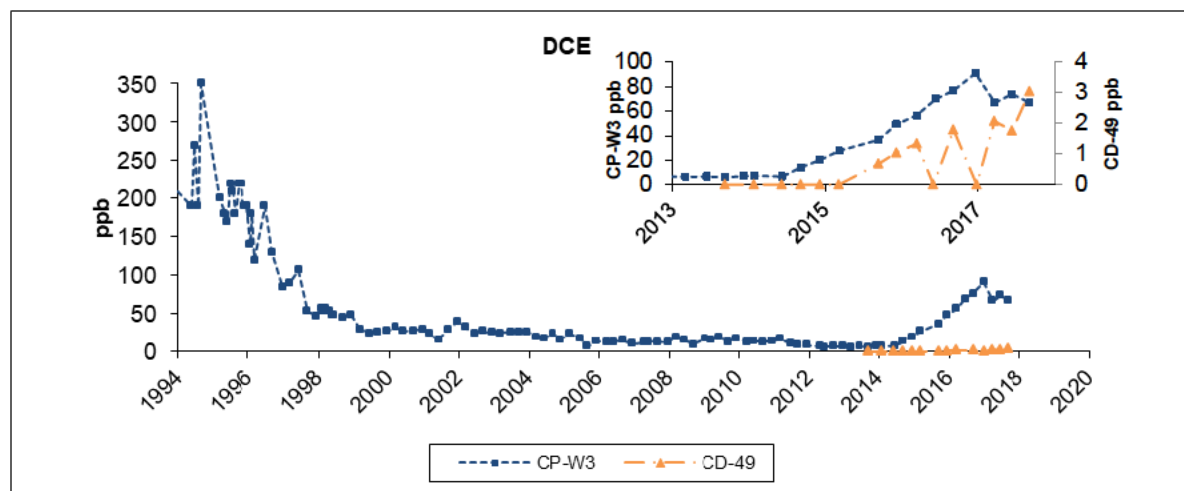


Figure 18. COC Concentrations at CP-W3.

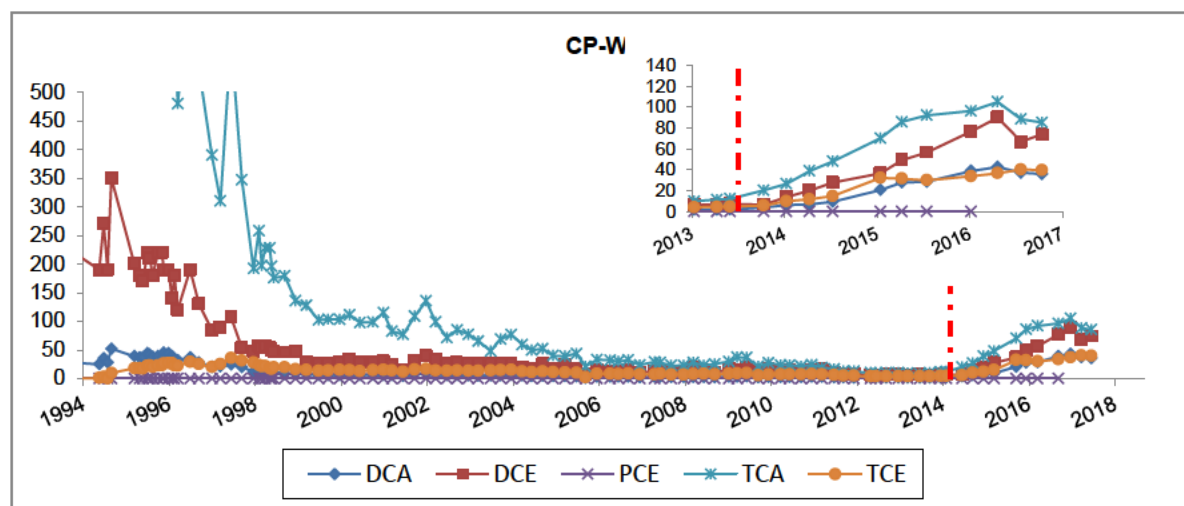
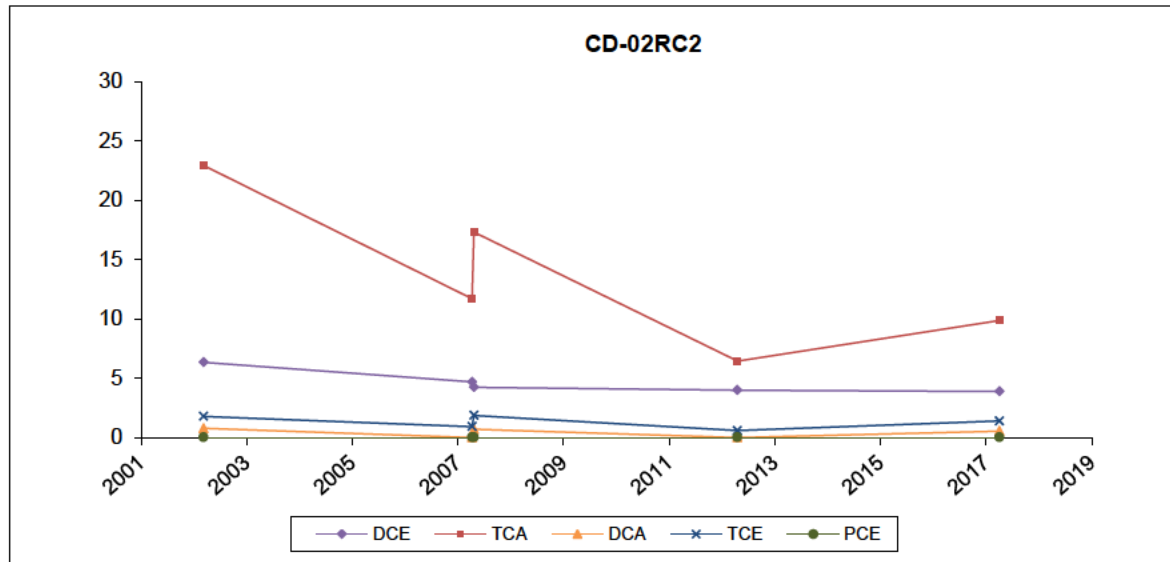


Figure 19. COC Concentrations at CD-02RC2.



\*During the 2007 supplemental sampling event, two samples were taken using two different sampling methods. Both are represented in this plot.

Figure 20. COC Concentrations at CD-24C2

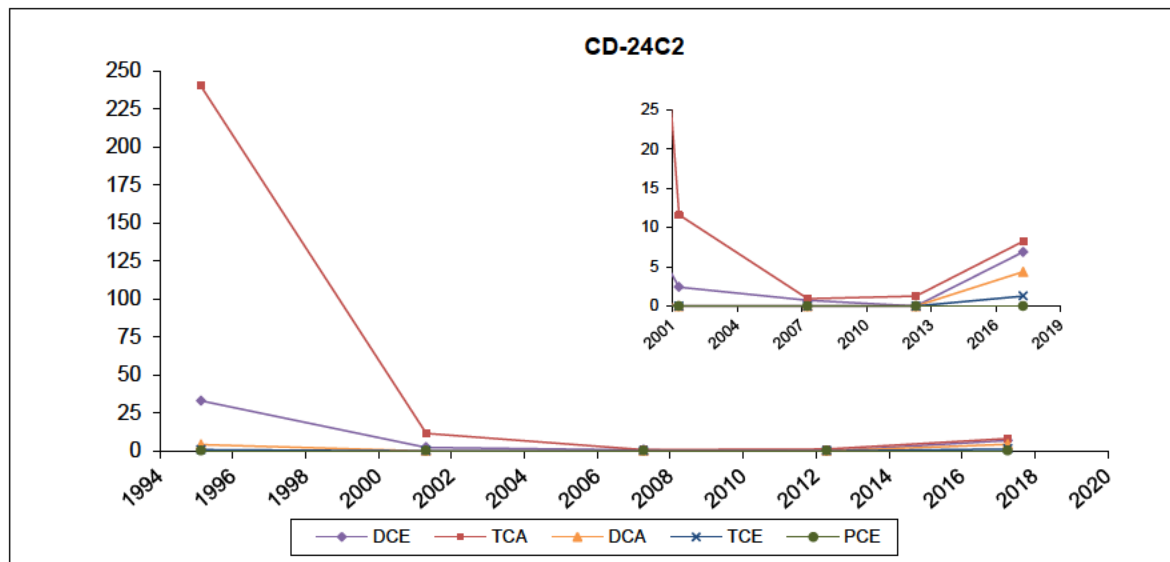


Figure 21. COC Concentrations at CD-21C1.



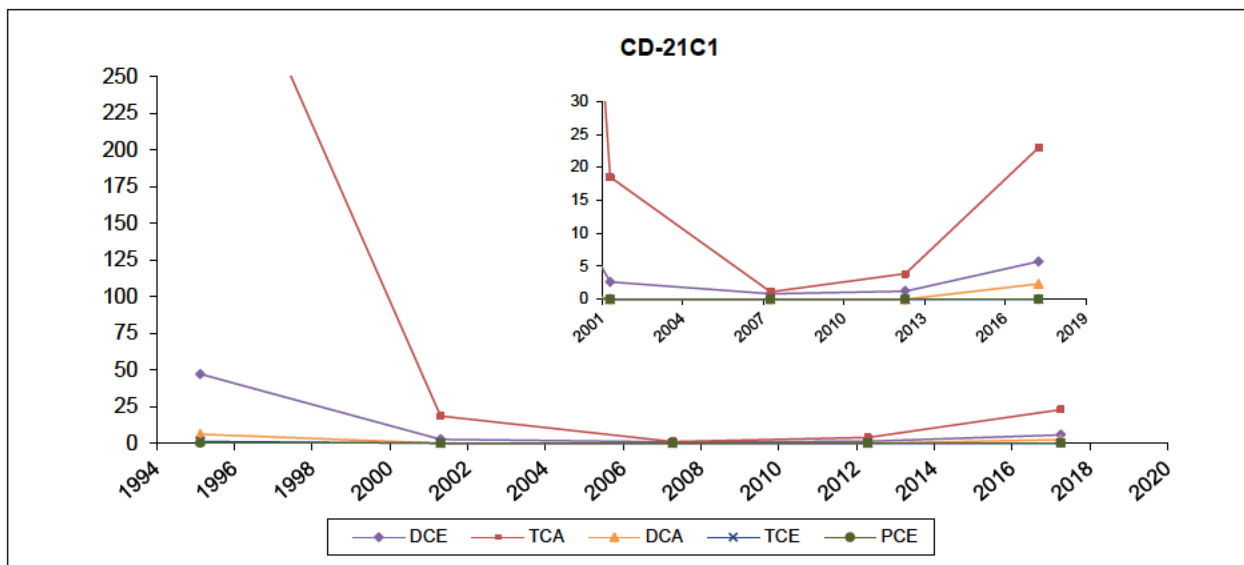
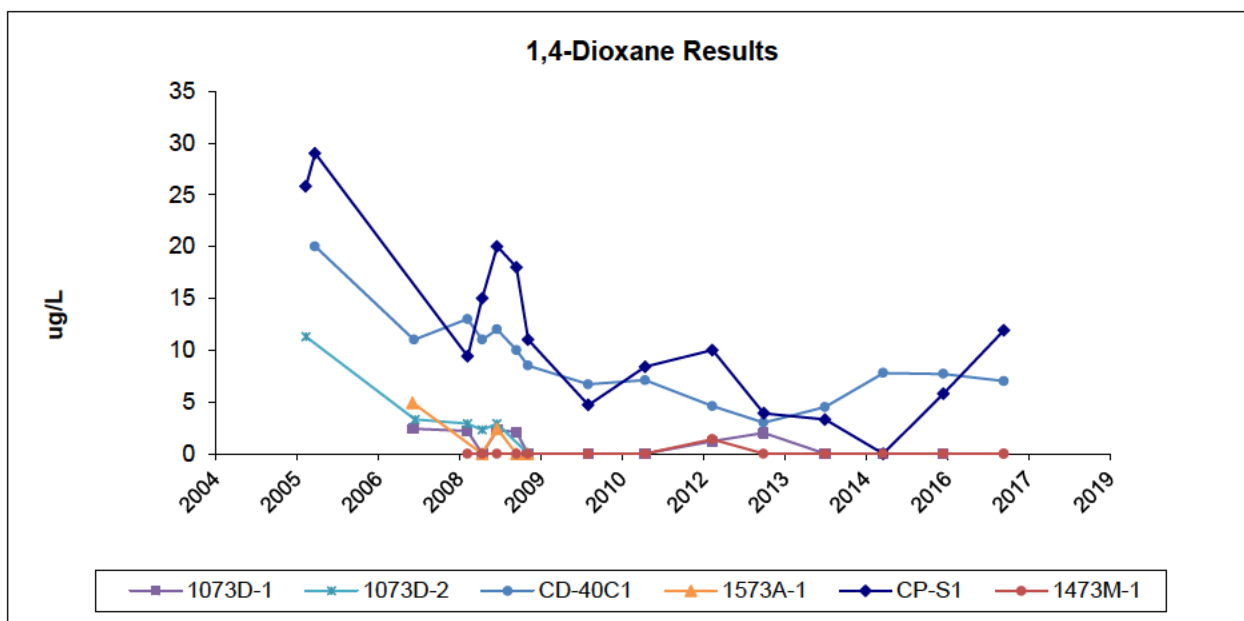


Figure 20. 1,4-Dioxane Concentrations at various monitoring wells.



## Appendix B. Notice Letter to Fairchild Air Force Base

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION X

1200 SIXTH AVENUE  
SEATTLE, WASHINGTON 98101



REPLY TO  
ATTN OF:

M/S 525

MAR 14 1984

Jim Spangler  
92 - CSG - DEEV  
Fairchild Air Force Base  
Fairchild AFB, WA 99011

Dear Mr. Spangler:

The Fairchild AFB has been preliminarily identified as a contributor of industrial waste to the Colbert Landfill, an EPA Superfund site. The Air Force has not been listed as a responsible party to the problem, but the possibility exists that you may become involved as the investigation proceeds.

Part of the responsibility of EPA is to identify parties that may have contributed to the groundwater contamination at the site. Fairchild AFB was identified as a disposer of industrial waste into the landfill during a preliminary screening of site records (see attached Table 2-1). This letter is to inform you that Fairchild AFB has been listed as a contributor to the site. Ultimately EPA will assemble an official list of responsible parties which will be involved in remedial cleanup and/or cost recovery actions to collect any EPA Superfund money spent for site cleanup. Therefore, we suggest that the Air Force review their records regarding waste disposal at Colbert Landfill, and that the developments at the Colbert Landfill be followed.

EPA has designated the Spokane County, Colbert Landfill as a Superfund hazardous waste site. This site has been under investigation since October, 1980, by the county. The next phase of the investigation will use federal Superfund money to finance some additional field investigation work and to prepare a feasibility study which will recommend the cost effective solution to the problem. The problem, as it is currently defined, is groundwater contamination. The principal contaminants are 1,1,1-trichloroethane and to a lesser extent by 1,1,1-trichloroethylene (and a few other compounds) with the source located at the Colbert Landfill site.

Spokane County Utilities Department, has been the lead agency during the previous investigatory work. Damon Taam, phone (b) (6), has been the county's project manager. EPA is currently developing a Cooperative Agreement (contract) with the Washington Department of Ecology for the management of the next phase of work ending with a recommended solution (Remedial Investigation and Feasibility Study (RIFS)). I have been

USEPA SF

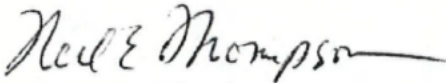


1454889

2.

identified as the EPA Project Manager for the Colbert Landfill site. I can be reached at (b)(6) If you have any questions or concerns please give me a call.

Sincerely,



Neil E. Thompson  
Regional Site Project Officer

Attachment

cc: Damon Taam, Spokane County  
John Littler, DOE



DRAFT

REMEDIAL ACTION MASTER PLAN  
COLBERT LANDFILL  
COLBERT, WASHINGTON.

01.OV01.0

29 July 1983

This document has been prepared for the U.S. Environmental Protection Agency under Contract No. 68-01-6692. The material contained herein is not to be disclosed to, discussed with, or made available to any person or persons for any reason without the prior express approval of a responsible official of the U.S. Environmental Protection Agency.

Table 2-1  
REPORTED HAZARDOUS MATERIALS  
DISPOSED OF AT THE COLBERT LANDFILL  
JUNE 1980

<u>Source</u>	<u>Compound</u>	<u>Quantity (gal/month)</u>
Key Tronics Corporation <sup>a</sup>	Methylene chloride (20-25% acrylic resins by weight)	400
	1,1,1-trichloroethane (20-25% acrylic resins by weight)	150-200
	Mixture of Above (10% acrylic resins by weight)	100-150
Fairchild Air Force Base	Methy Ethyl Ketone	25
	Poly Thinner	12.5
	Enamel Thinner	10
	Toluene	10
	Paint Remover	10
	Primer Wastes	10

<sup>a</sup>Total quantities listed do not agree with quantities reported disposed of by Key Tronics.

Source: Letter from Spokane Utilities to the Spokane County Health District dated June 4, 1980, regarding hazardous waste survey of materials disposed of at the Colbert and Mica landfills.

Appendix C. Laboratory results for CD-04E1, CD-04C1, and CD-54 (duplicate).

# Anatek Labs, Inc.

1282 Alturas Drive • Moscow, ID 83843 • (208) 883-2839 • Fax (208) 882-9246 • email moscow@anateklabs.com  
504 E Sprague Ste. D • Spokane WA 99202 • (509) 838-3999 • Fax (509) 838-4433 • email spokane@anateklabs.com

**Client:** SPOKANE COUNTY UTILITIES  
**Address:** 22515 N. ELK CHATTAROY ROAD  
COLBERT, WA 99005

**Batch #:** 170505025  
**Project Name:** SVL #X7E0115

**Attn:**

## Analytical Results Report

<b>Sample Number</b>	170505025-008	<b>Sampling Date</b>	5/4/2017	<b>Date/Time Received</b>	5/5/2017 10:20 AM
<b>Client Sample ID</b>	CD-04C1-170504	<b>Sampling Time</b>	9:30 AM		
<b>Matrix</b>	Water	<b>Sample Location</b>	X7E0115-08		
<b>Comments</b>					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
1,1,1,2-Tetrachloroethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,1,1-Trichloroethane	44.4	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,1,2,2-Tetrachloroethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,1,2-Trichloroethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,1-Dichloroethane	276	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,1-Dichloroethene	372	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,1-dichloropropene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2,3-Trichlorobenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2,3-Trichloropropane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2,4-Trichlorobenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2,4-Trimethylbenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2-Dibromo-3-chloropropane(DBCP)	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2-Dibromoethane (EDB)	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2-Dichlorobenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2-Dichloroethane	3.08	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2-Dichloropropane	1.85	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,3,5-Trimethylbenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,3-Dichlorobenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,3-Dichloropropane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,4-Dichlorobenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
2,2-Dichloropropane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
2-Butanone	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
2-Chlorotoluene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
4-Chlorotoluene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Acetone	ND	ug/L	2.5	5/10/2017	SAT	EPA 524.3	
Acrylonitrile	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Benzene	1.95	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Bromobenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	



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504 E Sprague Ste. D • Spokane WA 99202 • (509) 838-3999 • Fax (509) 838-4433 • email spokane@anateklabs.com

**Client:** SPOKANE COUNTY UTILITIES  
**Address:** 22515 N. ELK CHATTAROY ROAD  
COLBERT, WA 99005

**Batch #:** 170505025  
**Project Name:** SVL #X7E0115

**Attn:**

## Analytical Results Report

<b>Sample Number</b>	170505025-008	<b>Sampling Date</b>	5/4/2017	<b>Date/Time Received</b>	5/5/2017 10:20 AM
<b>Client Sample ID</b>	CD-04C1-170504	<b>Sampling Time</b>	9:30 AM		
<b>Matrix</b>	Water	<b>Sample Location</b>	X7E0115-08		
<b>Comments</b>					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
Bromochloromethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Bromodichloromethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Bromoform	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Bromomethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Carbon disulfide	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Carbon Tetrachloride	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Chlorobenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Chloroethane	0.77	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Chloroform	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Chloromethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
cis-1,2-dichloroethene	4.45	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
cis-1,3-Dichloropropene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Dibromochloromethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Dibromomethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Dichlorodifluoromethane	3.12	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Diethyl ether	23.3	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Ethylbenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Hexachlorobutadiene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Iodomethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Isopropylbenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
m+p-Xylene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Methylene chloride	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
methyl-t-butyl ether (MTBE)	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Naphthalene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
n-Butyl benzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
n-Propylbenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
o-Xylene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
p-isopropyltoluene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	

# Anatek Labs, Inc.

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504 E Sprague Ste. D • Spokane WA 99202 • (509) 838-3999 • Fax (509) 838-4433 • email spokane@anateklabs.com

**Client:** SPOKANE COUNTY UTILITIES  
**Address:** 22515 N. ELK CHATTAROY ROAD  
COLBERT, WA 99005

**Batch #:** 170505025  
**Project Name:** SVL #X7E0115

**Attn:**

## Analytical Results Report

Sample Number	170505025-008	Sampling Date	5/4/2017	Date/Time Received	5/5/2017 10:20 AM		
Client Sample ID	CD-04C1-170504	Sampling Time	9:30 AM				
Matrix	Water	Sample Location	X7E0115-08				
Comments							
Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
sec-Buty benzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Styrene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
tert-Buty benzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Tetrachloroethene	2.26	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Toluene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Total Xylene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
trans-1,2-Dichloroethene	0.65	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
trans-1,3-Dichloropropene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
trans-1-4-Dichloro-2-butene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Trichloroethene	13.7	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Trichlorofluoromethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Vinyl Chloride	2.19	ug/L	0.5	5/10/2017	SAT	EPA 524.3	

## Surrogate Data

Sample Number	170505025-008		
Surrogate Standard	Method	Percent Recovery	Control Limits
1,2-Dichlorobenzene-d4	EPA 524.3	90.4	70-130
Bromofluorobenzene	EPA 524.3	93.2	70-130
Toluene-d8	EPA 524.3	91.4	70-130

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COLBERT, WA 99005

**Batch #:** 170505025  
**Project Name:** SVL #X7E0115

**Attn:**

## Analytical Results Report

<b>Sample Number</b>	170505025-009	<b>Sampling Date</b>	5/4/2017	<b>Date/Time Received</b>	5/5/2017 10:20 AM
<b>Client Sample ID</b>	CD-04E1-170504	<b>Sampling Time</b>	11:30 AM		
<b>Matrix</b>	Water	<b>Sample Location</b>	X7E0115-09		
<b>Comments</b>					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
1,1,1,2-Tetrachloroethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,1,1-Trichloroethane	36.4	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,1,2,2-Tetrachloroethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,1,2-Trichloroethane	0.60	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,1-Dichloroethane	241	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,1-Dichloroethene	326	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,1-dichloropropene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2,3-Trichlorobenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2,3-Trichloropropane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2,4-Trichlorobenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2,4-Trimethylbenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2-Dibromo-3-chloropropane(DBCP)	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2-Dibromoethane (EDB)	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2-Dichlorobenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2-Dichloroethane	3.13	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,2-Dichloropropane	1.77	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,3,5-Trimethylbenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,3-Dichlorobenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,3-Dichloropropane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
1,4-Dichlorobenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
2,2-Dichloropropane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
2-Butanone	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
2-Chlorotoluene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
4-Chlorotoluene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Acetone	ND	ug/L	2.5	5/10/2017	SAT	EPA 524.3	
Acrylonitrile	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Benzene	1.94	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Bromobenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	

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**Client:** SPOKANE COUNTY UTILITIES  
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COLBERT, WA 99005

**Batch #:** 170505025  
**Project Name:** SVL #X7E0115

**Attn:**

## Analytical Results Report

<b>Sample Number</b>	170505025-009	<b>Sampling Date</b>	5/4/2017	<b>Date/Time Received</b>	5/5/2017 10:20 AM
<b>Client Sample ID</b>	CD-04E1-170504	<b>Sampling Time</b>	11:30 AM		
<b>Matrix</b>	Water	<b>Sample Location</b>	X7E0115-09		
<b>Comments</b>					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
Bromochloromethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Bromodichloromethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Bromoform	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Bromomethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Carbon disulfide	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Carbon Tetrachloride	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Chlorobenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Chloroethane	0.82	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Chloroform	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Chloromethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
cis-1,2-dichloroethene	4.51	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
cis-1,3-Dichloropropene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Dibromochloromethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Dibromomethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Dichlorodifluoromethane	3.06	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Diethyl ether	23.9	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Ethylbenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Hexachlorobutadiene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Iodomethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Isopropylbenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
m+p-Xylene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Methylene chloride	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
methyl-t-butyl ether (MTBE)	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Naphthalene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
n-Butyl benzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
n-Propylbenzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
o-Xylene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
p-isopropyltoluene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	



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COLBERT, WA 99005

**Batch #:** 170505025  
**Project Name:** SVL #X7E0115

**Attn:**

## Analytical Results Report

Sample Number	170505025-009	Sampling Date	5/4/2017	Date/Time Received	5/5/2017 10:20 AM		
Client Sample ID	CD-04E1-170504	Sampling Time	11:30 AM				
Matrix	Water	Sample Location	X7E0115-09				
Comments							
Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
sec-Buty benzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Styrene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
tert-Buty benzene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Tetrachloroethene	2.26	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Toluene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Total Xylene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
trans-1,2-Dichloroethene	0.64	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
trans-1,3-Dichloropropene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
trans-1-4-Dichloro-2-butene	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Trichloroethene	13.4	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Trichlorofluoromethane	ND	ug/L	0.5	5/10/2017	SAT	EPA 524.3	
Vinyl Chloride	2.18	ug/L	0.5	5/10/2017	SAT	EPA 524.3	

## Surrogate Data

<b>Sample Number</b>	170505025-009		
Surrogate Standard	Method	Percent Recovery	Control Limits
1,2-Dichlorobenzene-d4	EPA 524.3	90.2	70-130
Bromofluorobenzene	EPA 524.3	87.0	70-130
Toluene-d8	EPA 524.3	90.2	70-130

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## Analytical Results Report

<b>Sample Number</b>	170505025-010	<b>Sampling Date</b>	5/4/2017	<b>Date/Time Received</b>	5/5/2017 10:20 AM
<b>Client Sample ID</b>	CD-54-170504	<b>Sampling Time</b>	12:00 PM		
<b>Matrix</b>	Water	<b>Sample Location</b>	X7E0115-10		
<b>Comments</b>					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
1,1,1,2-Tetrachloroethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,1,1-Trichloroethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,1,2,2-Tetrachloroethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,1,2-Trichloroethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,1-Dichloroethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,1-Dichloroethene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,1-dichloropropene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,2,3-Trichlorobenzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,2,3-Trichloropropane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,2,4-Trichlorobenzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,2,4-Trimethylbenzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,2-Dibromo-3-chloropropane(DBCP)	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,2-Dibromoethane (EDB)	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,2-Dichlorobenzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,2-Dichloroethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,2-Dichloropropane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,3,5-Trimethylbenzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,3-Dichlorobenzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,3-Dichloropropane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
1,4-Dichlorobenzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
2,2-Dichloropropane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
2-Butanone	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
2-Chlorotoluene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
4-Chlorotoluene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Acetone	ND	ug/L	2.5	5/11/2017	SAT	EPA 524.3	
Acrylonitrile	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Benzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Bromobenzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	

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**Batch #:** 170505025  
**Project Name:** SVL #X7E0115

**Attn:**

## Analytical Results Report

<b>Sample Number</b>	170505025-010	<b>Sampling Date</b>	5/4/2017	<b>Date/Time Received</b>	5/5/2017 10:20 AM
<b>Client Sample ID</b>	CD-54-170504	<b>Sampling Time</b>	12:00 PM		
<b>Matrix</b>	Water	<b>Sample Location</b>	X7E0115-10		
<b>Comments</b>					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
Bromochloromethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Bromodichloromethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Bromoform	0.70	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Bromomethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Carbon disulfide	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Carbon Tetrachloride	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Chlorobenzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Chloroethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Chloroform	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Chloromethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
cis-1,2-dichloroethene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
cis-1,3-Dichloropropene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Dibromochloromethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Dibromomethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Dichlorodifluoromethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Diethyl ether	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Ethylbenzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Hexachlorobutadiene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Iodomethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Isopropylbenzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
m+p-Xylene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Methylene chloride	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
methyl-t-butyl ether (MTBE)	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Naphthalene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
n-Butyl benzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
n-Propylbenzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
o-Xylene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
p-isopropyltoluene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	

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**Batch #:** 170505025  
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## Analytical Results Report

<b>Sample Number</b>	170505025-010	<b>Sampling Date</b>	5/4/2017	<b>Date/Time Received</b>	5/5/2017 10:20 AM
<b>Client Sample ID</b>	CD-54-170504	<b>Sampling Time</b>	12:00 PM		
<b>Matrix</b>	Water	<b>Sample Location</b>	X7E0115-10		
<b>Comments</b>					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
sec-Buty benzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Styrene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
tert-Buty benzene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Tetrachloroethene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Toluene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Total Xylene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
trans-1,2-Dichloroethene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
trans-1,3-Dichloropropene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
trans-1-4-Dichloro-2-butene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Trichloroethene	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Trichlorofluoromethane	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	
Vinyl Chloride	ND	ug/L	0.5	5/11/2017	SAT	EPA 524.3	

## Surrogate Data

<b>Sample Number</b>	170505025-010		
Surrogate Standard	Method	Percent Recovery	Control Limits
1,2-Dichlorobenzene-d4	EPA 524.3	99.8	70-130
Bromofluorobenzene	EPA 524.3	88.8	70-130
Toluene-d8	EPA 524.3	86.2	70-130

## **APPENDIX D:**

### **TRI-LATERAL DIAGRAM EXAMPLE**



One method to understand the fate and transport pathways in a plume containing 1,1,1-TCA parent and daughter products is to develop trilateral diagrams. Trilateral diagrams are constructed by calculating the percent (%) molar concentration of each constituent (1,1,1-TCA, 1,1-DCE and 1,1-DCA) in the groundwater sample relative to the total molar concentration of the three compounds together. The relative % molar concentrations are plotted on a three-sided graph, indicating the relative contribution of each constituent to the whole. Trilateral diagrams can be constructed from sampling data to compare the molar ratios of 1,1,1-TCA and its daughter products at various locations and times. By looking at the ratios of constituents in different locations in the plume, the plot can indicate if groundwater in different areas is impacted by preferential flow paths or different attenuation mechanisms.

## How to Read a Trilateral Diagram

Ternary diagrams are designed to graphically represent proportions of three related components in a system.

Axes are scaled so they increase in a clockwise direction around the diagram. Points within the diagram represent the relative proportions of three classes and always sum to 1.

Data from well sampling in ug/L is converted to molar concentrations (moles/L).

Concentrations for each component are converted to fractions (%) of the total (i.e. [moles 1,1,1-TCA]/[moles Total Chlorinated Solvent]) and plotted on the diagram.

For example, in the adjacent diagram, the fractions of 1,1,1-TCA, 1,1-DCA, and 1,1-DCE are illustrated for data from three different locations.

